

MEADOWS

Locomotive Coaling Stations

Civil Engineering

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LOCOMOTIVE COALING STATIONS

BY

DAVID STANLEY MEADOWS

THESIS

FOR THE

DEGREE OF BACHELOR OF SCIENCE

IN

CIVIL ENGINEERING

COLLEGE OF ENGINEERING

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THIS IS TO CERTIFY THAT THE THESIS PREPARED UNDER MY SUPERVISION BY

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IS APPROVED BY ME AS FULFILLING THIS PART OF THE REQUIREMENTS FOR THE

DEGREE OF Bachelor of Science in Civil Engineering

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LOCOMOTIVE COALING STATIONS.

INTRODUCTION.

"A coaling station is the name applied to the appliances and conveniences which have been adopted for supplying locomotive tenders with coal. In its broader sense it included tracks, storage bins, derricks, coal chutes and all machinery connected with taking coal from the cars in which it is shipped and placing it in store for future use, or for delivering it either directly from cars or from store to engine tenders."

In this paper the following outline will be followed:

I-Description of the various types of plants used in this country.

II-Discussion of Cost Data.

III-Factors governing the selection of the type of plant to be erected.

IV-Conclusions.

V-Cinder pits and ^{cinder} handling devices.

I.

DESCRIPTION OF COALING STATIONS.

The plants in use in this country may be divided into twelve types according to the method of handling the coal, as follows:

A-Shoveling from railroad cars to tenders.

B-Shoveling to high platforms to be shoveled again to tenders.

C-Crane and bucket system from storage platforms; hand filled buckets.



D-Shoveling from cars to bins from elevated trestle.

E-Dumping directly to bins from railroad cars on trestle.

F-Hauling up steep incline by cable and dumping to bins.

G-Dumping from railroad cars and elevating by conveyor.

H-Dumping from railroad cars and elevating by air hoist.

I-Locomotive crane working from stock pile or cars to tenders.

J-Dumping through trestle and tramping to tenders.

K-Dumping to pit and elevating skip by engine taking coal.

L-Handling from cars or pits by clamshell or similar buckets.

A-Shoveling from Cars to Tenders-The type of station in which the coal is shoveled directly from railroad cars to tenders is the most primitive of all the types in use. It requires no permanent plant other than two parallel tracks. It is slow and costly to operate and is justly regarded as a temporary makeshift for points where only a small amount of coal is to be handled.

B-Shoveling to High Platform-In a place where the coal car track can be easily placed at a small elevation above the engine track, a high platform has been introduced as a modification of "A". Where the period of usefulness of such a plant is great enough to warrant the cost, this type offers two advantages over the preceding one. It admits of employing the shovelers continuously and provides some storage space. The fact that the coal must be handled twice is not as great a disadvantage as would at first appear. In type "A" it was necessary to lift the coal from the bottom of the coal car and throw it over the side of a tender as high or higher than the side of the car and some two or three feet away. When the platform is used the shovelers have only to lift the coal over the side of the car and drop it on the platform. The platform should be built high enough to do away with the lift over the side of the tender.

C-Crane and Bucket-Another step in advance is the use of a jib crane for lifting the coal to the tender. A plant of the crane and bucket type consists of a low storage platform, a jib crane and usually ten or twelve buckets or tubs. These tubs are fitted with truck wheels, and are filled by hand at any part of the platform and pushed to the derrick. The tubs hold one-half ton or one ton each, but the smaller size seems to meet with the most favor. A modification of this form is in use on some roads where a small number of engines are to receive coal. Buckets enough for a day's supply are filled by hand and placed near an air hoist which is furnished with power from the locomotive and operated by the engine men.

D-E-F-Trestle Types-The most common class of coaling stations is one in which the railroad cars are placed on an elevated trestle and unloaded into pockets from which coal falls to the tenders by gravity. Types "D" and "E" differ only in the way the coal is removed from the cars.



"THE TRESTLE SYSTEM"

In the plants listed as "D" the coal is shoveled from the cars to the pockets. In type "E" plants the coal is delivered to the station either in hopper bottom or side dumping cars, and the coal is allowed to run into the pockets by gravity. The disadvantage of cars of this kind is that it is not possible to distribute small amounts of coal to different parts of the trestle.



Coaling Station for Michigan Central Railroad, at West Detroit Mich. Capacity, 500 tons.

Fig.2. Type "F"

There are two methods of placing the cars on the trestle. In "D" and "E" the approach to the trestle is built on a 5% grade, and the cars pushed to the top by a switch engine. This operation is always attended by some danger and inconvenience. The switch engine may not always be available when coal is needed at the chute, and it is not uncommon to see a car pushed completely over the end of the trestle, (See Figure 1). The approach must of necessity be

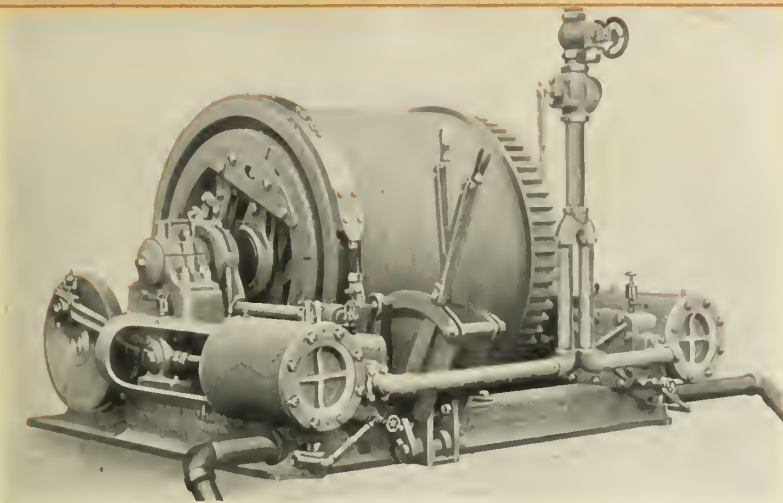


FIGURE 1 TYPE OF ENGINE USED FOR LOCOMOTIVE-COALING PLANT

Fig. 3 Steam Power.

long, and must be strongly braced to withstand the shock of an engine and a cut of cars coming upon it at high speed. The other method of placing cars on the trestle is by hauling them up a steep incline with a cable operated by a small gasoline or steam hoisting engine. (See Figure 2.)

Fairbanks-Morse Coal Car Hoist

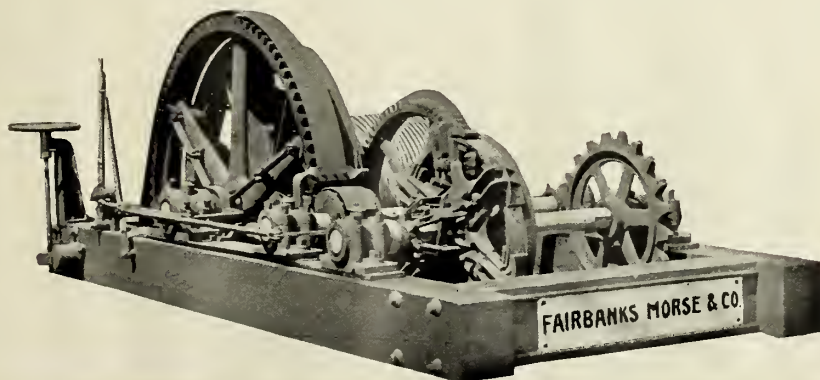


Fig. 4 Gasoline Power.

This method admits of the use of a 20% grade, requiring a trestle only one-fourth as long as that required by the other method. The approach may also be made much lighter, as it only carries the load of one slowly moving coal car instead of three or four rapidly moving cars and a locomotive. The storage track for loaded coal cars should have sufficient down grade toward the foot of the approach to allow

loaded cars to roll to a position where they can be picked up by the cable.

G-Conveyor Plants-Another important class of plants is that in which the cars are unloaded into a pit below the coal car track from which the coal is elevated to the chutes by some form of conveying machinery. One firm uses canvas belt conveyors, and there are several chain and bucket conveyors on the market for this purpose, (See Figures 5 to 20). These mechanical plants have some very decided advantages in that they provide better storage facilities than any of the other types and occupy less ground space.



Coaling Station at Syracuse, N. Y., for the N. Y. C. & H. R. R. R. Storage capacity, 820 tons.

Fig. 5.

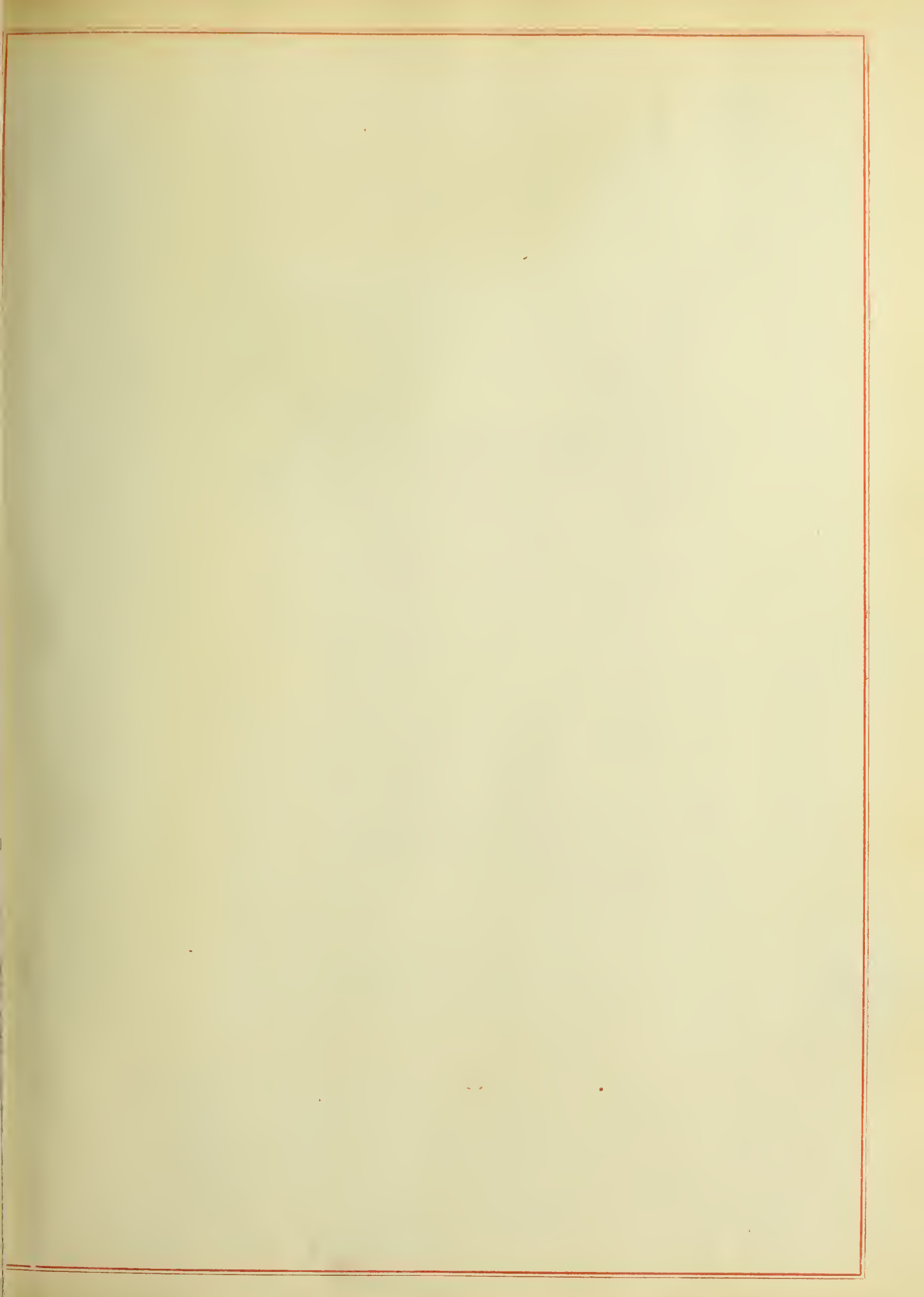
The coal is stored in closed bins with sloping bottoms in the upper part of the structures. Here it is protected from the weather and does not occupy valuable ground space. The high cost of construction and maintenance is the disadvantage of this kind of plant. These facts will be more fully discussed in parts III & IV.

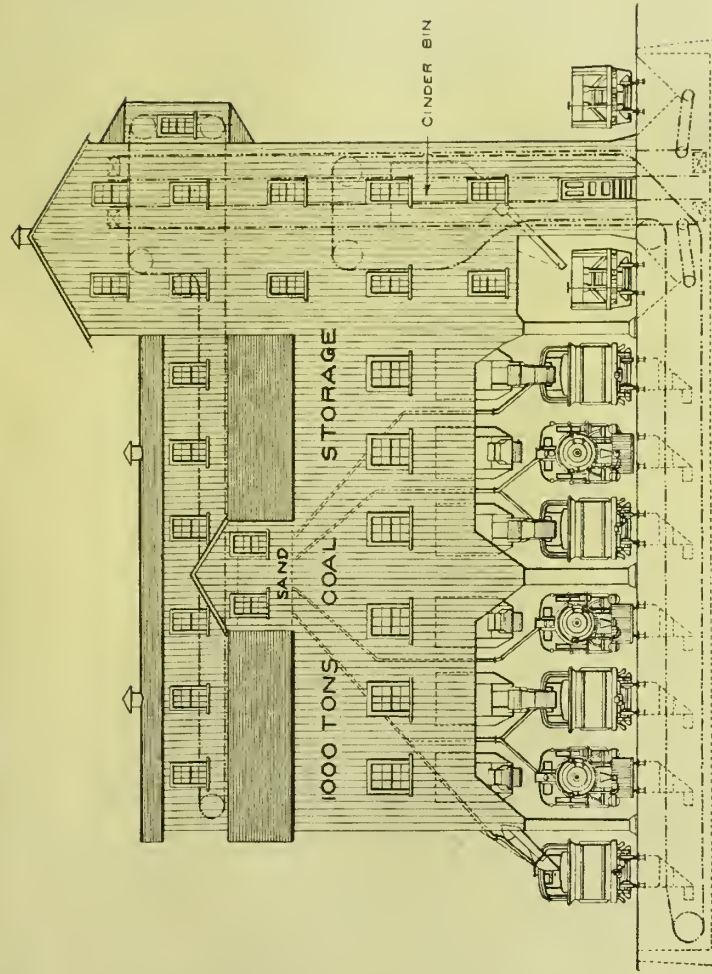


Fig. 6. Coaling Station at Effingham, Ill.

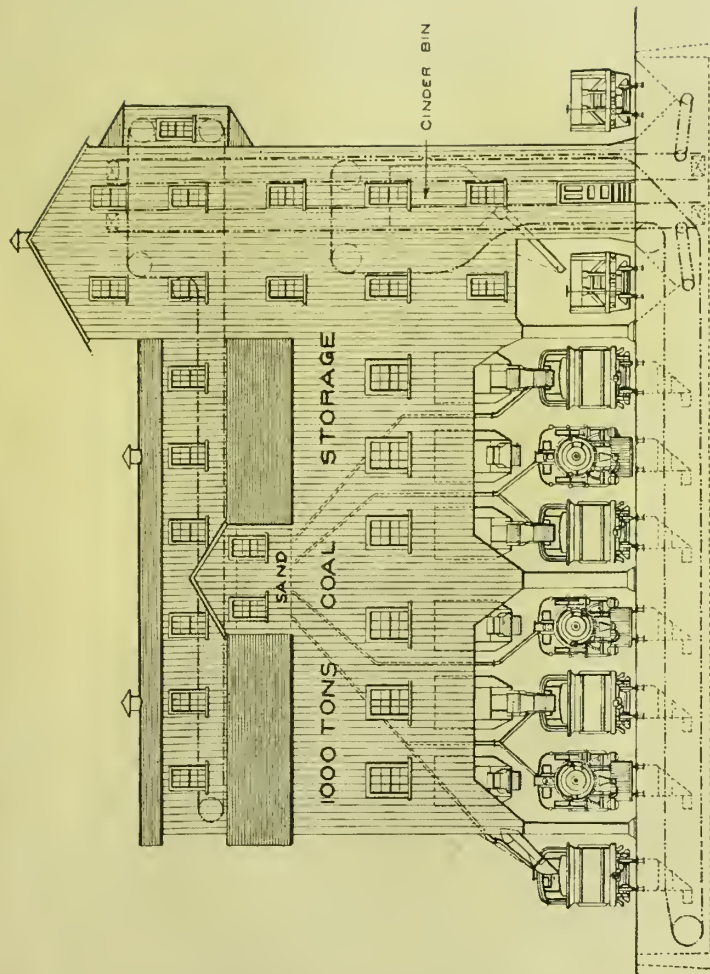


Fig. 7. Coaling Station at Washington, O.



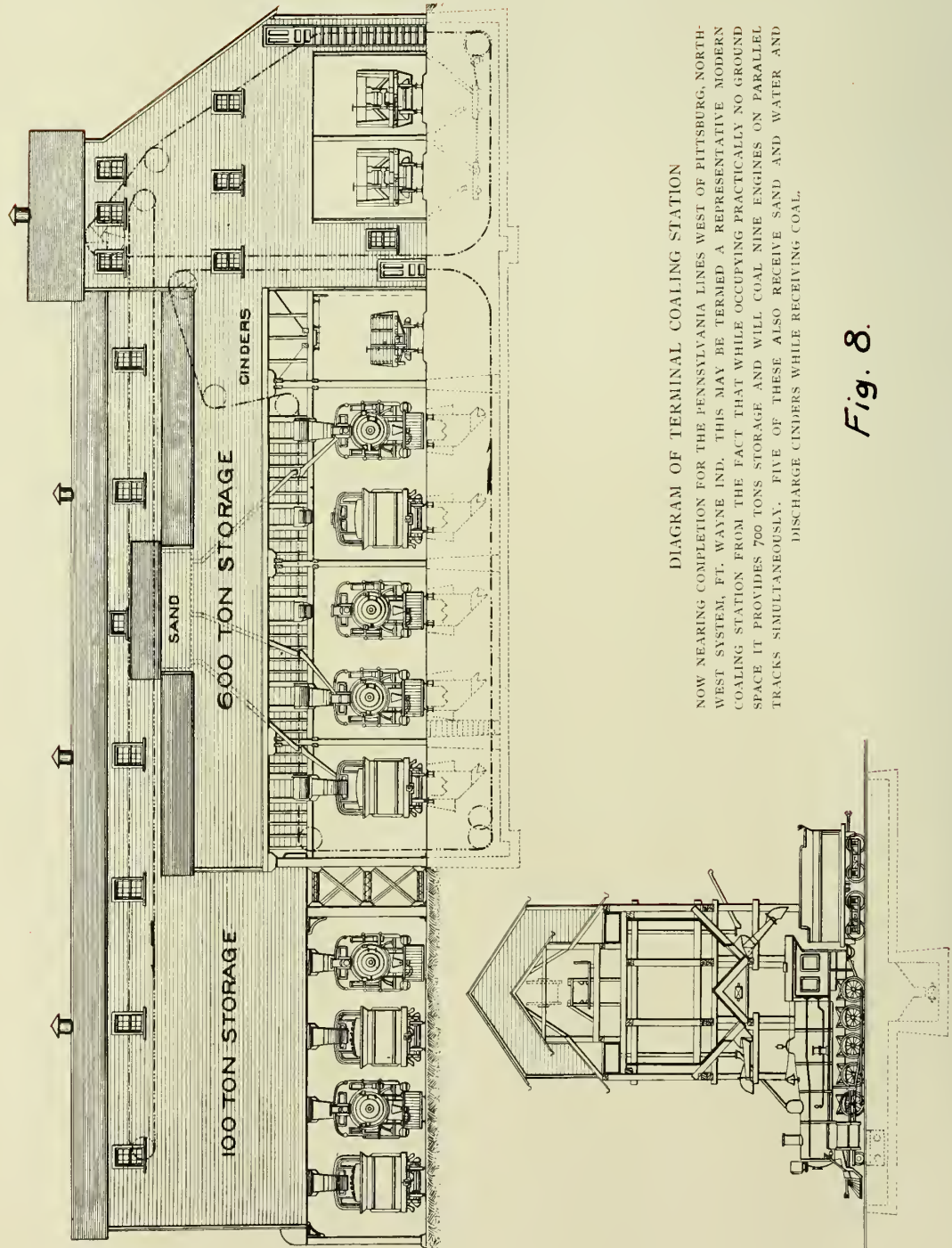


SIDE ELEVATION COALING STATION
UNDER CONSTRUCTION FOR THE TERMINAL RAILROAD ASSOCIATION,
ST. LOUIS, MO.



SIDE ELEVATION COALING STATION
UNDER CONSTRUCTION FOR THE TERMINAL RAILROAD ASSOCIATION.
ST. LOUIS, MO.

The Link - Belt Companies





COALING STATION
NEARING COMPLETION FOR THE PENNSYLVANIA LINES WEST OF
PITTSBURG, NORTH-WEST SYSTEM, FORT WAYNE, IND. SEE
DIAGRAM ON OPPOSITE PAGE.

Fig. 9.

The Link - Belt Companies

ON the opposite page we show a 600-ton terminal station, recently completed for the Pennsylvania Lines, West of Pittsburg, South-West System, Columbus, Ohio. All coal is carried in a single pocket, facing two tracks. The machinery handles 100 tons run of mine coal per hour, and is driven by an electric motor.

A separate plant installed by us for handling cinders at this point is illustrated and described on page 41.

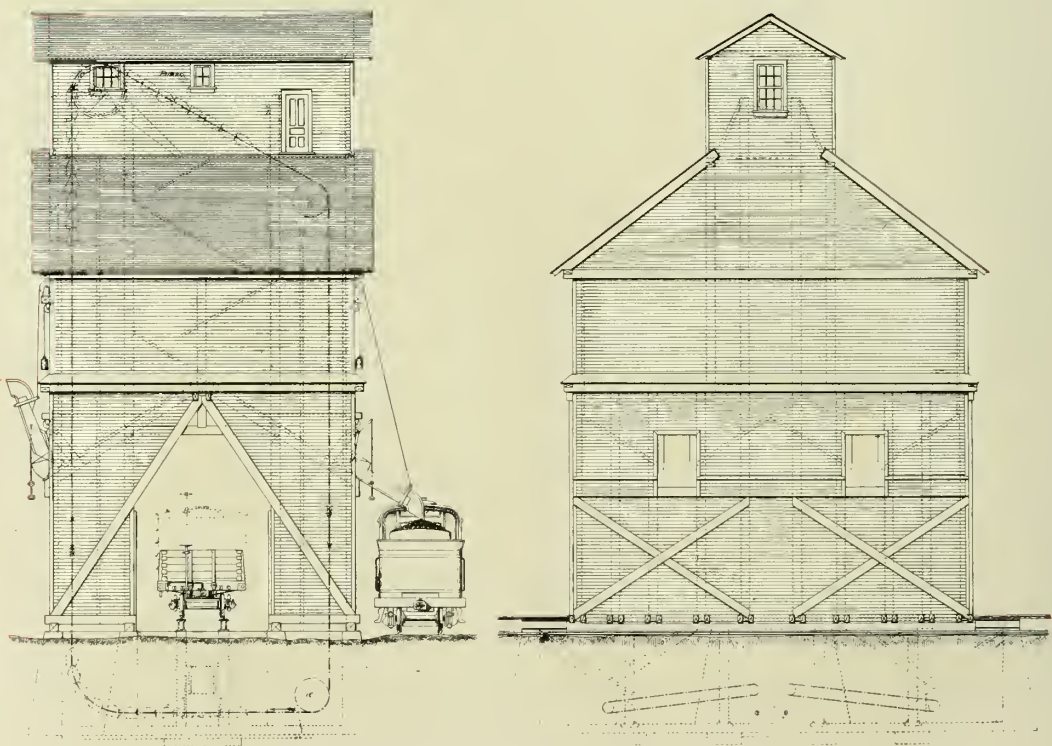


DIAGRAM OF COALING STATION SHOWN ON OPPOSITE PAGE.

Fig. 10.

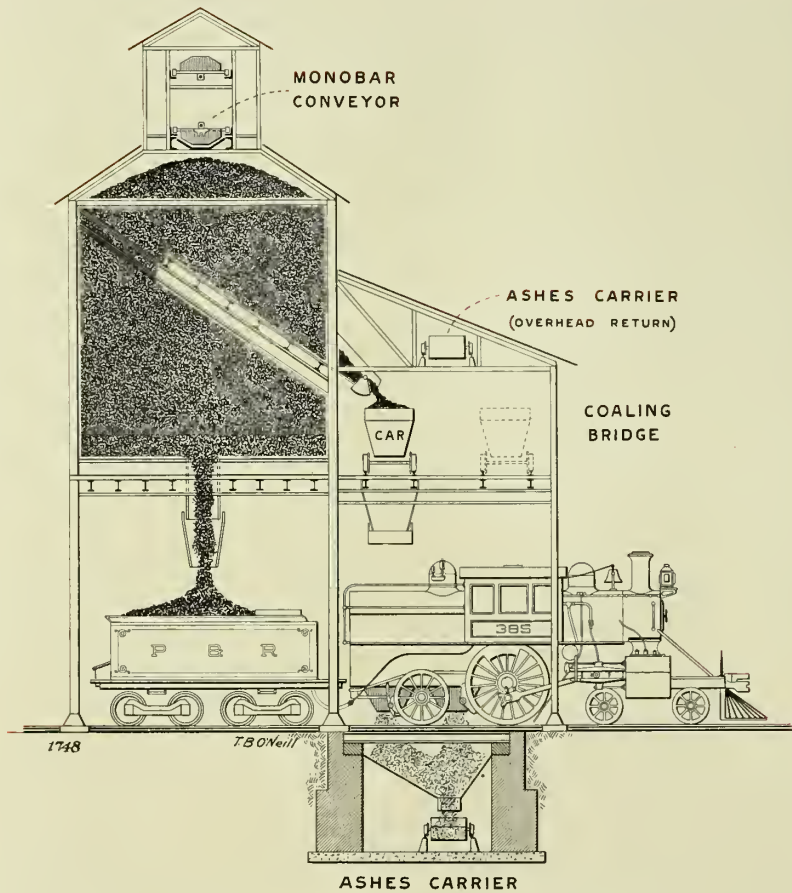


TERMINAL COALING STATION

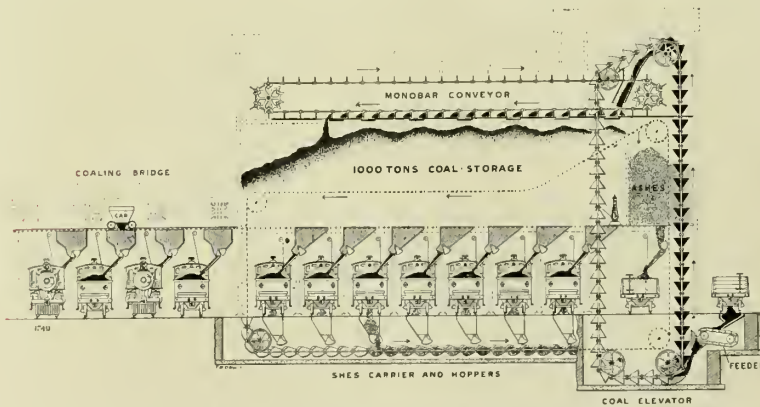
ERECTED IN 1902 FOR THE PENNSYLVANIA LINES WEST
OF PITTSBURG, SOUTH-WEST SYSTEM, COLUMBUS, OHIO
SEE DIAGRAM ON OPPOSITE PAGE

Fig. 11.

The Link - Belt Companies



THIS VIEW SHOWS AN ENGINE TAKING COAL AND CLEANING ASH PAN SIMULTANEOUSLY; ALSO METHOD OF DELIVERY OF COAL TO CAR ON BRIDGE.



THIS VIEW SHOWS ELEVEN ENGINES TAKING COAL, SEVEN OF WHICH ARE DUMPING ASHES; A CAR TAKING ASHES FROM ASHES POCKET AND A CAR DELIVERING COAL TO ELEVATOR, WHICH, IN TURN, IS DELIVERING TO OVERHEAD DISTRIBUTING CONVEYOR. SUPPLEMENTARY TO VIEW SHOWN ON OPPOSITE PAGE.

Fig. 12.



Fig. 13.

LOCOMOTIVE COAL AND CINDER STATION

IN THE PENNSYLVANIA AVENUE SUBWAY OF THE PHILADELPHIA & READING RAILWAY, PHILADELPHIA, PA. STORAGE CAPACITY 1,000 TONS. COAL IS DELIVERED TO LOCOMOTIVES ON YARD TRACKS BY CHUTES FROM POCKET AND ON THROUGH SERVICE TRACKS FROM OVERHEAD BRIDGE. TWELVE ENGINES CAN RECEIVE COAL SIMULTANEOUSLY WHILE SEVEN OF THESE ARE DUMPING CINDERS.

The Link - Belt Companies

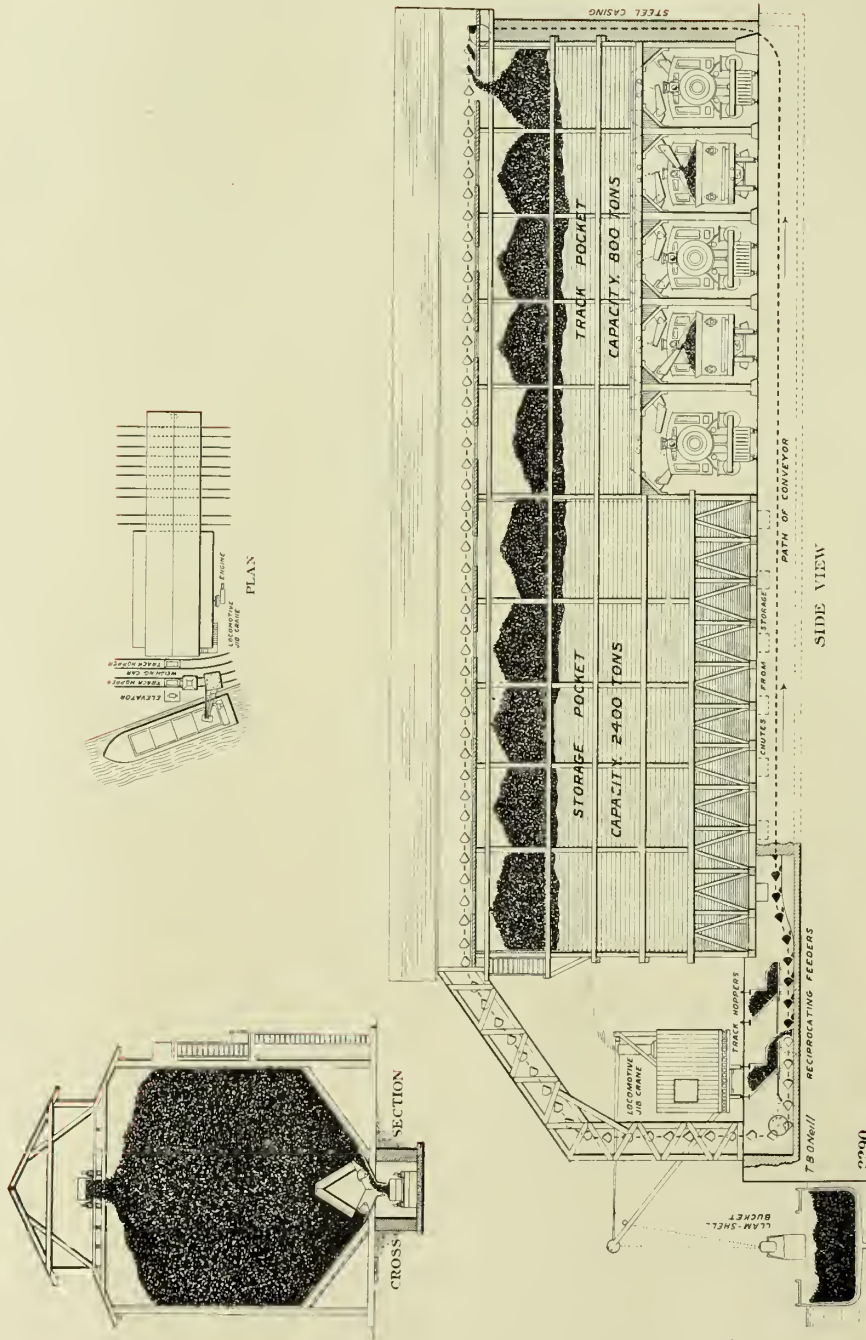


DIAGRAM OF COALING STATION
LONG ISLAND CITY RAILWAY, LONG ISLAND CITY, N. Y.

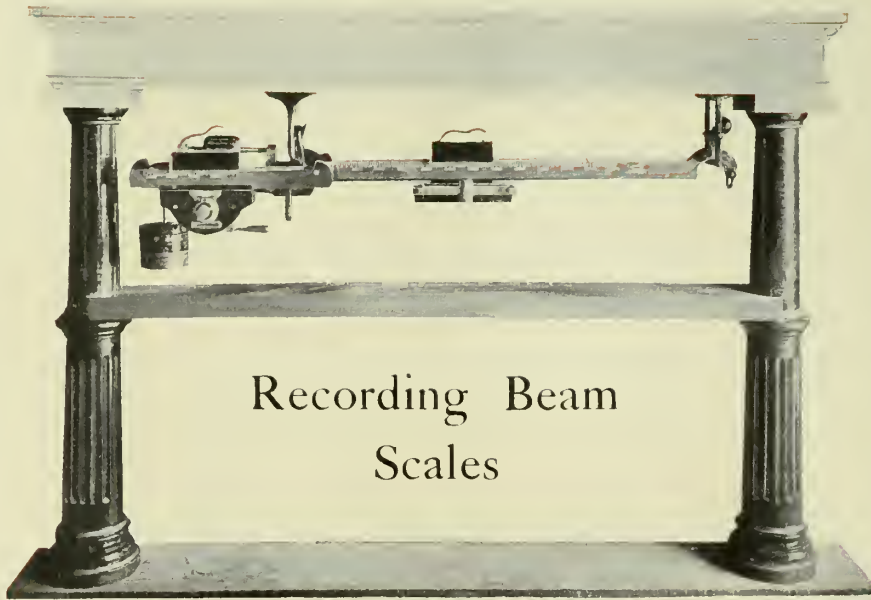
Fig. 14.



Fig. 15.

LOCOMOTIVE COALING STATION

LONG ISLAND CITY, LONG ISLAND, N. Y., LONG ISLAND RAILROAD. STORAGE CAPACITY 3,200 TONS. COAL IS DELIVERED BY ONE CONVEYOR TO OVERHEAD POCKET AND TO AUXILIARY STORAGE POCKET. THE SAME CONVEYOR IS ALSO USED IN TRANSFERRING COAL FROM AUXILIARY STORAGE POCKET TO OVERHEAD POCKET.



Recording Beam Scales

TO prevent wasteful or extravagant consumption of coal, many roads keep an accurate record of the quantity consumed by each locomotive, while in other cases the uniting of different roads for terminal purposes necessitates the weighing of all coal delivered as a basis on which to apportion charges. In either event it is highly important that both the weights and records should be accurate. Our scales are of the most accurate make, and are equipped with a recording device which automatically registers the exact weight of each draught as delivered, thus preventing errors by careless or incompetent weighmen.

At stations of this type, coal to be weighed is carried in pockets holding from ten to ninety tons, each mounted on a recording beam scale, the beam of which is placed in the most accessible position.

When coal is to be taken out, the scale beam is first balanced by a sliding balance-weight. The coal is then drawn and the beam again balanced, this time by the recording weight, after which the operator merely presses a lever and receives a card upon which the exact weight of coal delivered is printed in plain numerals. He then notes thereon the number of engine supplied, and turns it in.

The operation consumes no appreciable time.

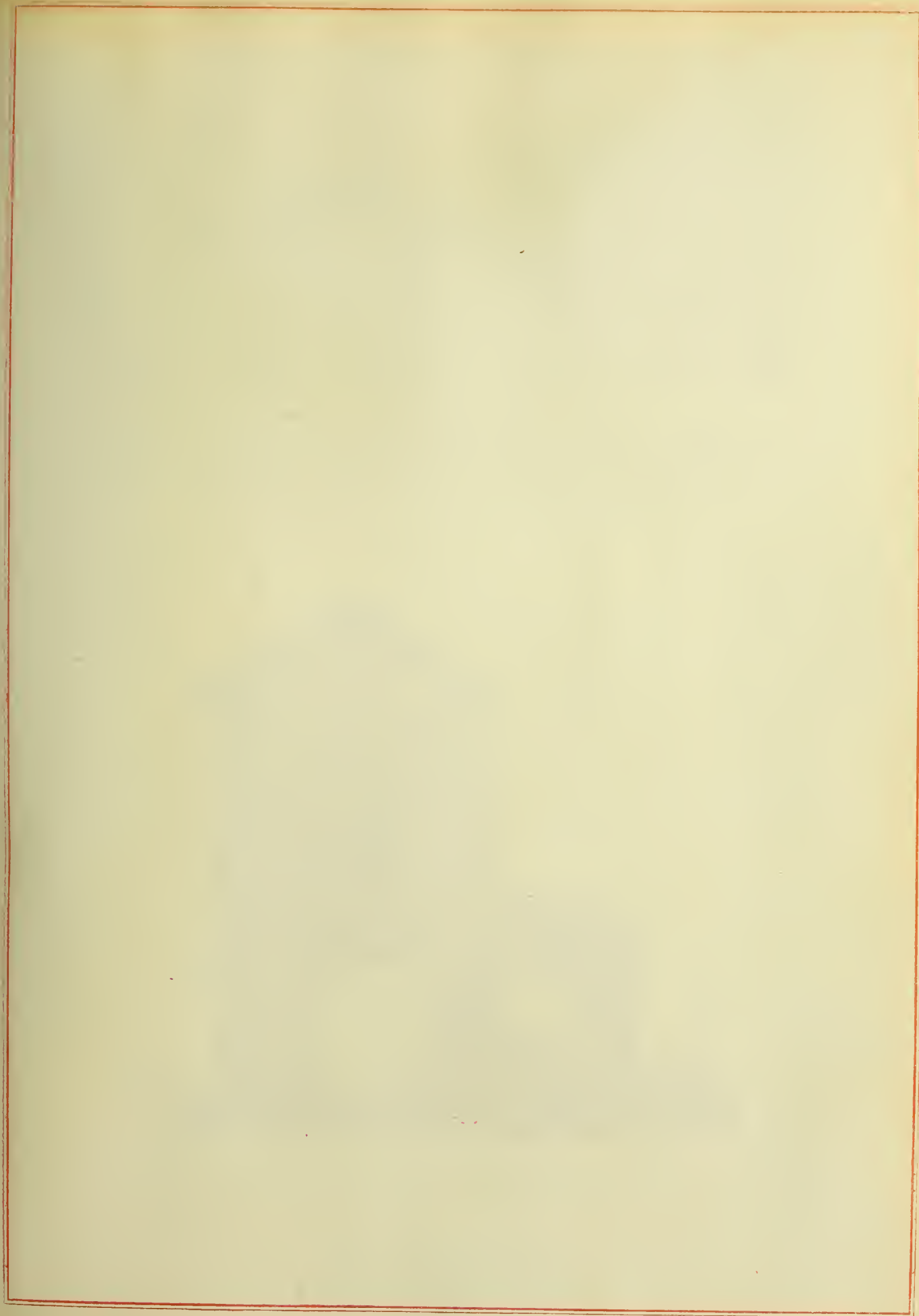




Fig. 16.
Pennsylvania Coaling Station at Cleveland O.



Coaling Station at Port Huron, Mich., on Pere Marquette R. R. Storage capacity, 160 tons. We have erected twelve similar coaling stations for this road.

Fig. 17.



*FRISCO
COALING STATION
NEAR
WATSEKA, ILL.*

Fig. 18

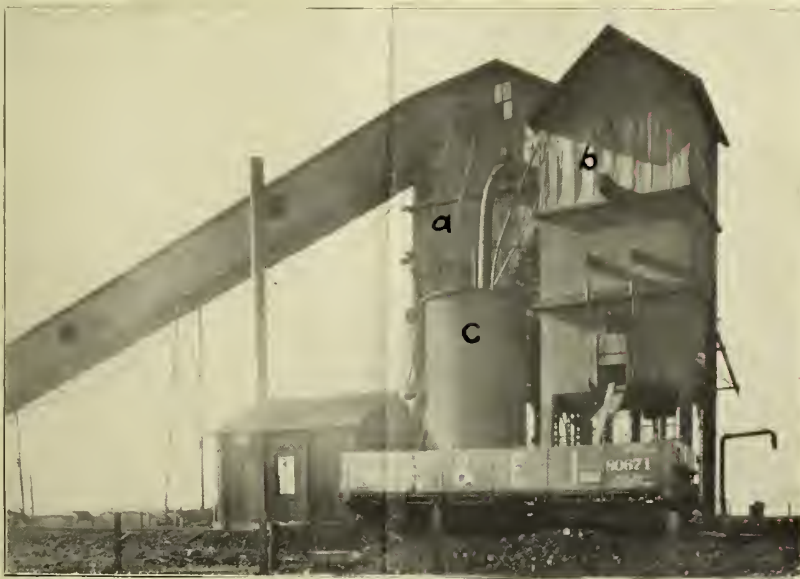


Fig. 19.

*a-Coal Pocket
b-Cinder Bin
c-Sand Bin*

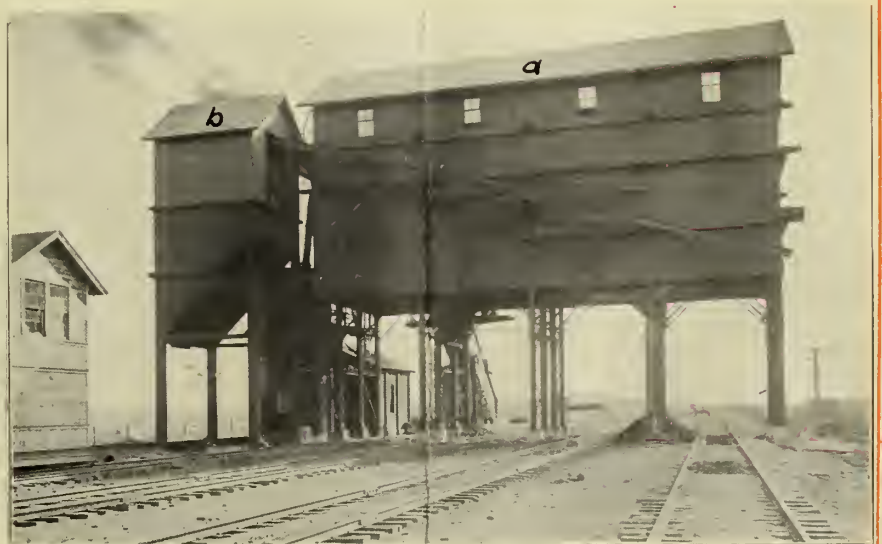


Fig. 20.

H-Dumping from Cars and Elevating by Hoist—The Holmen stations are of this type. The coal is allowed to fall into a hopper under the track and is hoisted to the storage bin by two hoists working alternately. The gates which control the flow of the coal to the tubs are automatic. There are other plants similar to the Holmen which provide storage below a trestle and only hoist a small amount of coal to the coal-ing pockets as needed.



Fig. 21. Type 'H.'

I-Locomotive Crane—On some of the eastern roads coal has been successfully handled by a locomotive crane working either from cars directly to tenders or from cars to stock pile, and thence to tenders.

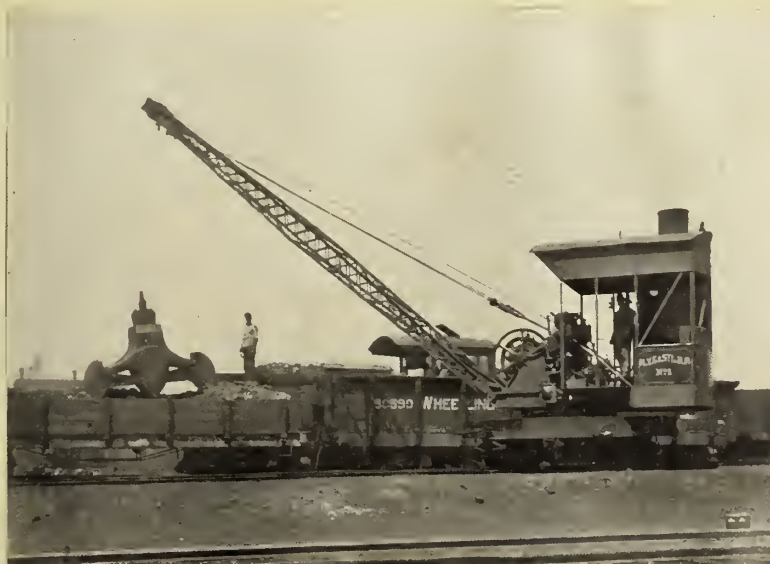


Figure 4. Brownhoist Locomotive-coaling Crane.
Filling bucket from coal-car.

Fig. 22. Type I.

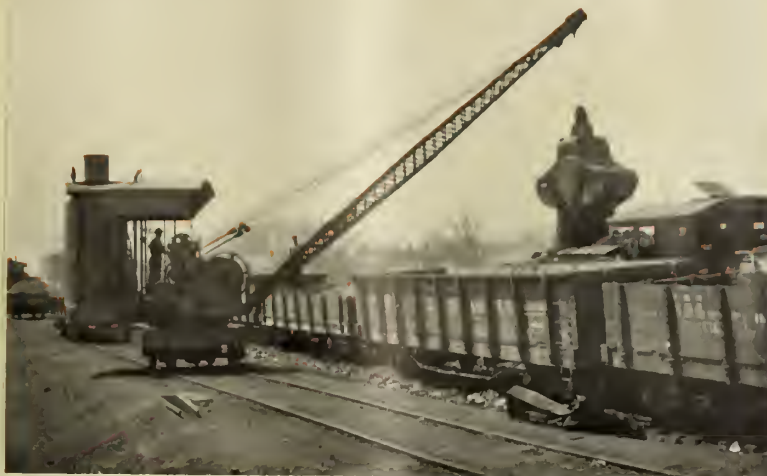


Figure 5. Brownhoist Locomotive-coaling Crane.
Depositing coal on locomotive-tender.
At Bellevue, Ohio, New York, Chicago & St. Louis Railroad.

Fig. 23

The cranes are of the ordinary locomotive type fitted with grab buckets as shown in the illustrations. The crane can handle coal or cinders equally well and is also available for light wrecking operations in the yards. The buckets have a capacity of about two thousand pounds of coal.

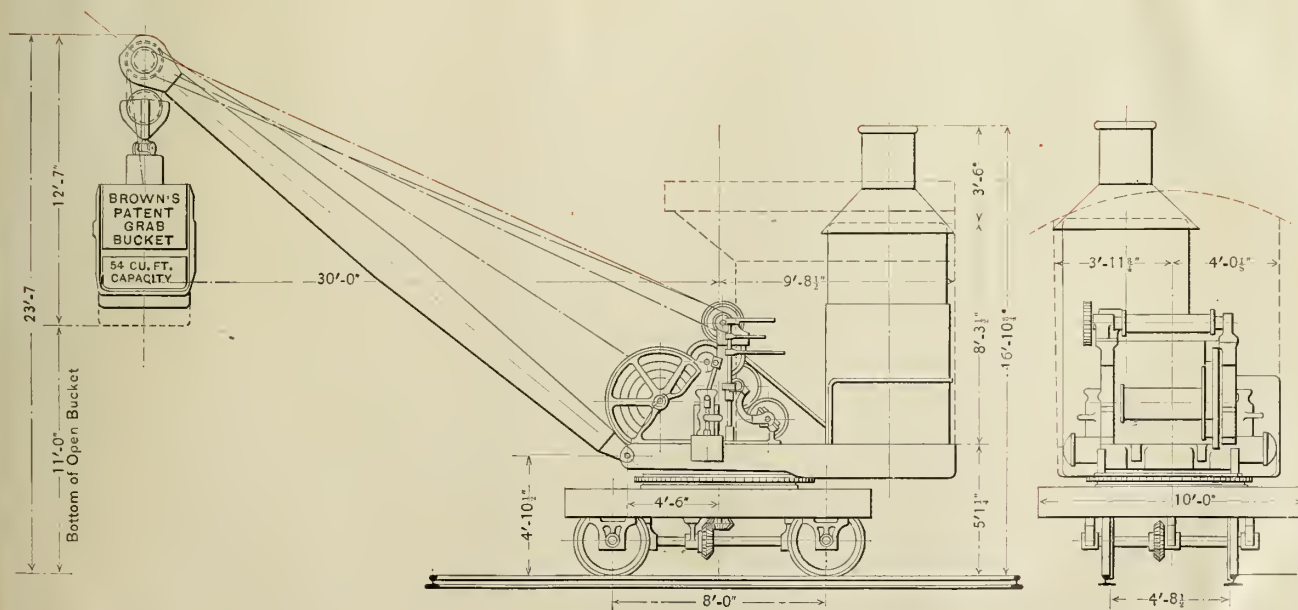


Figure 8. Clearance Dimensions, Brownhoist Locomotive-coaling Crane, with four-wheel rigid trucks

Fig. 24.

J-Tramming from Trestle-A

system which was very much in vogue a few years ago was one in which the coal cars were run up on a high trestle and the coal dumped or shoveled to a platform a little higher than a locomotive tank. The coal was then shoveled into small barrows or push cars and wheeled to the tender. The method is slow and costly, and has been superseded by other methods except on one or two roads which burn a mixture of anthracite and bituminous coals that require mixing at the coaling station.



COALING ("DOUBLE HEADER") ON B. & O.

Fig. 25. Type "K."

K-Elevating by Locomotive-One of the eastern roads, some years ago, adopted a novel form of coaling plant, which has since been abandoned. As the engine approached the point where it was to receive coal a cable was attached to the coupler and as the engine moved forward the coal skip was raised by the engine about to receive the coal. The scheme was unsatisfactory because of its slowness and danger. Only one engine could be handled at a time and it was necessary to uncouple the engine from its train, in coaling. Several of the men were killed or maimed by the cable's breaking or slipping from the coupler and thus dropping the skip.

L-Elevating by Buckets-Another form of station which is similar in appearance to the conveyor plants is illustrated on the following

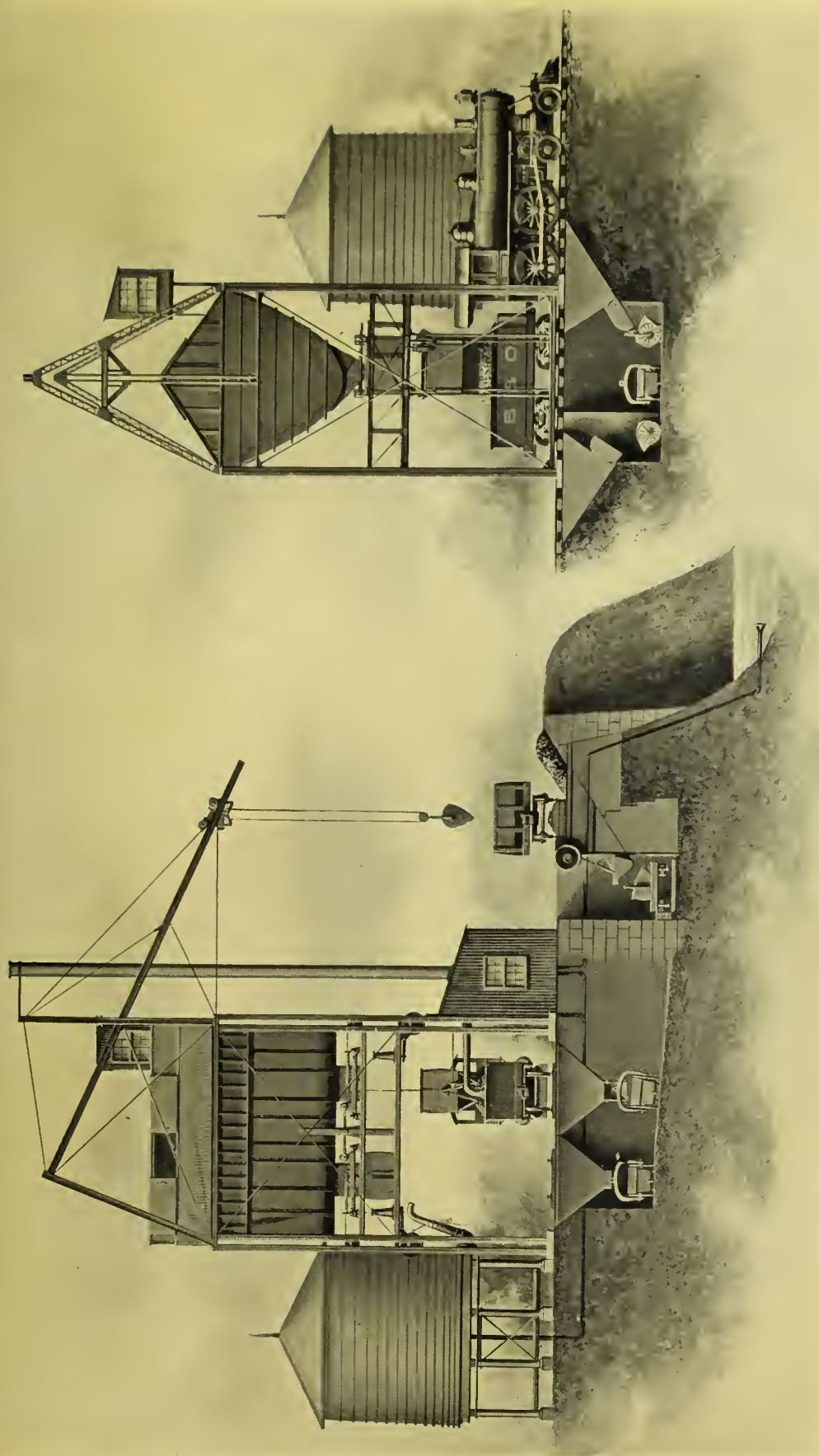


FIGURE 4. SIDE AND END SECTION OF "BROWNHOIST" LOCOMOTIVE-COALING STATION

Fig. 27. Type "L"

coal-pocket and to locomotive-tender by this plant with minimum breakage of the coal, where non-breakage of the coal is considered a valuable feature, for the hoisting and conveying apparatus allows of the lowering and dumping of the tub directly against the coal in the pocket, and it is not necessary that the coal should fall through any distance in dumping.

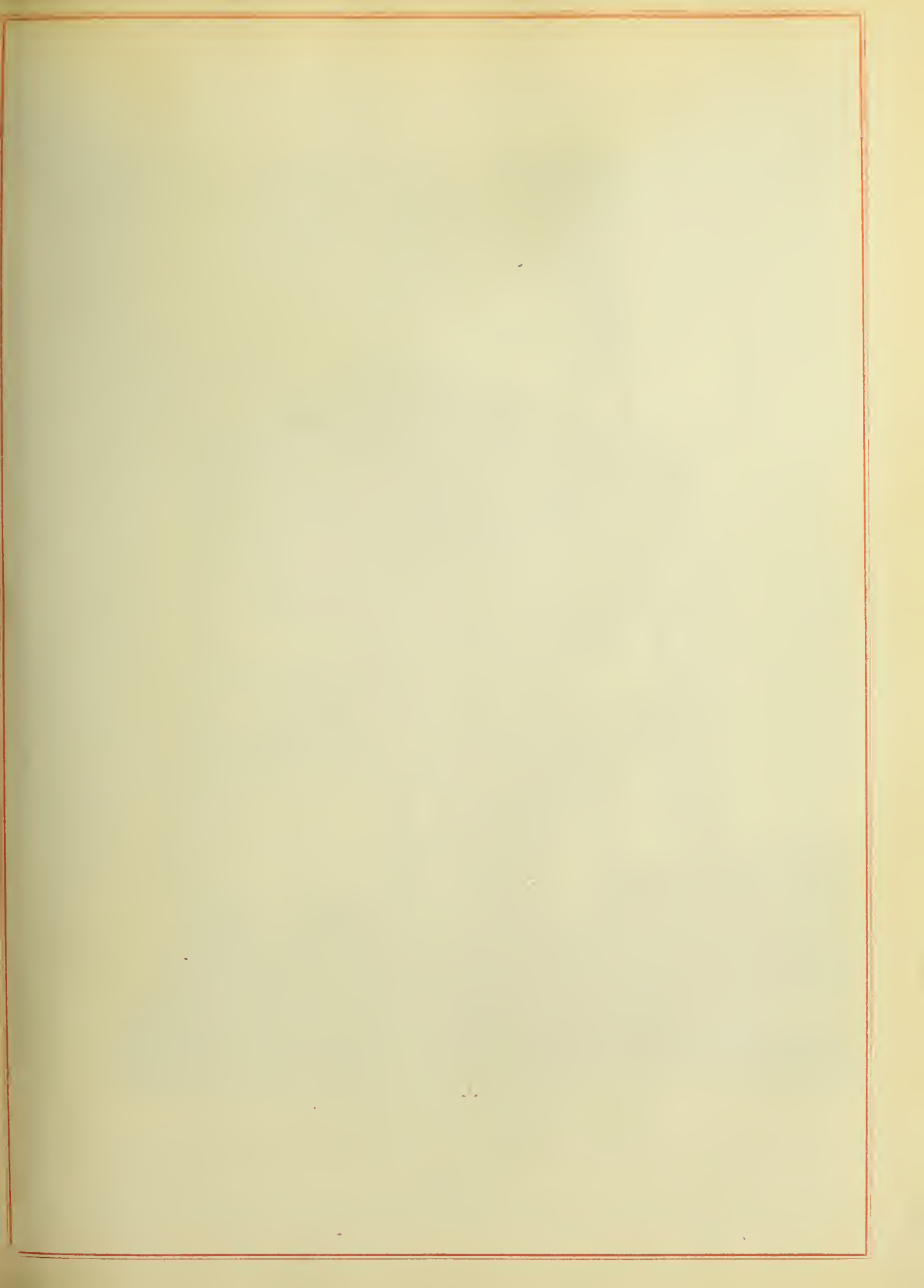
WATER-SUPPLY FOR LOCOMOTIVES. The steam-plant can supply the pump for filling the water-tank shown in the picture for locomotive water-supply, and the same men who operate the coaling-station can attend to this.

SAND-SUPPLY. Dry sand can likewise be prepared and furnished locomotives from this coaling-plant without increasing the working force.

STEAM-CAPSTANS. One or more steam-capstans can be supplied for pulling the loaded coal- and ash-cars along siding to position for loading or unloading, if required.

LIGHTING. When desired, a dynamo can be added to engine-room for lighting the plant at night by electricity.

CHANGES. The general arrangement shown in the picture can, of course, be modified to meet local conditions, and we are, therefore, always ready to cheerfully furnish plans and prices on receipt of full information from any one interested.



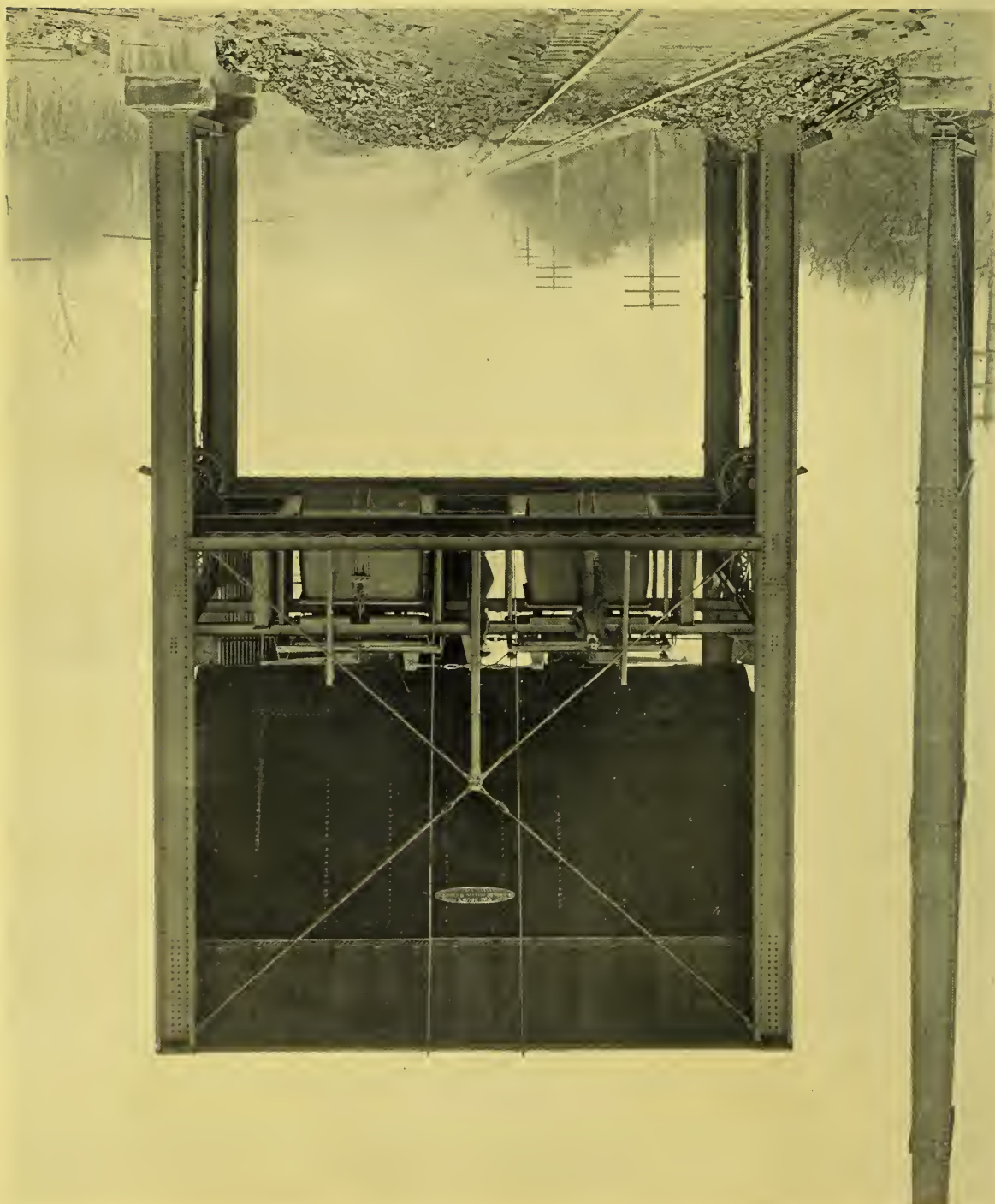


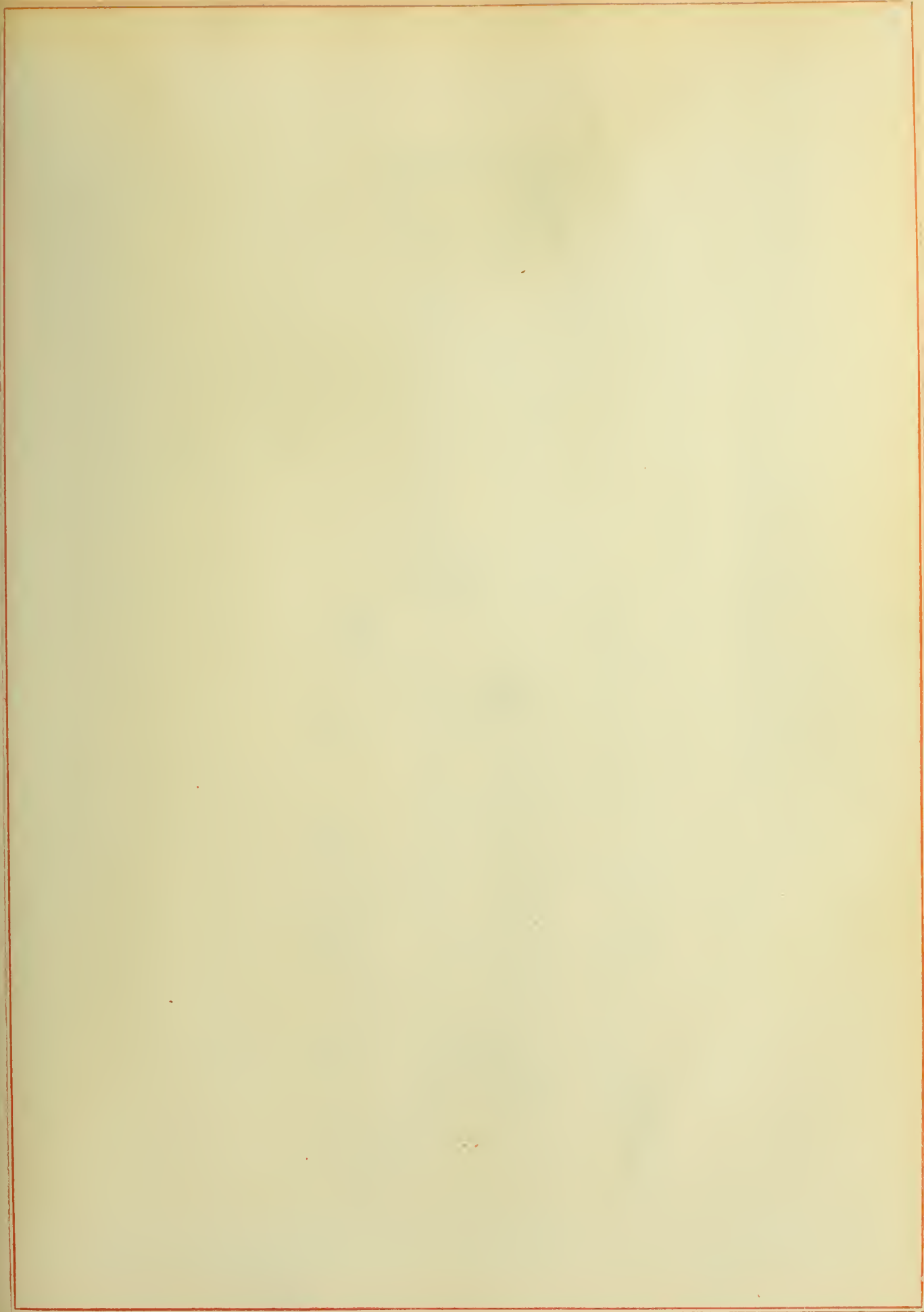
THE BROWN HOISTING MACHINERY CO.

Locomotive-coaling Station built for the BALTIMORE & OHIO RAILROAD at Kings Mines, Ohio.
Showing locomotive taking coal from gravity bottom-dumping tub.

Fig. 28

THE BROWN HOISTING MACHINERY CO.
Locomotive-coaling Station built for the BALTIMORE & OHIO RAILROAD at Kings Mines, Ohio.
Showing tubs in upper portion, filled, ready to supply locomotive.





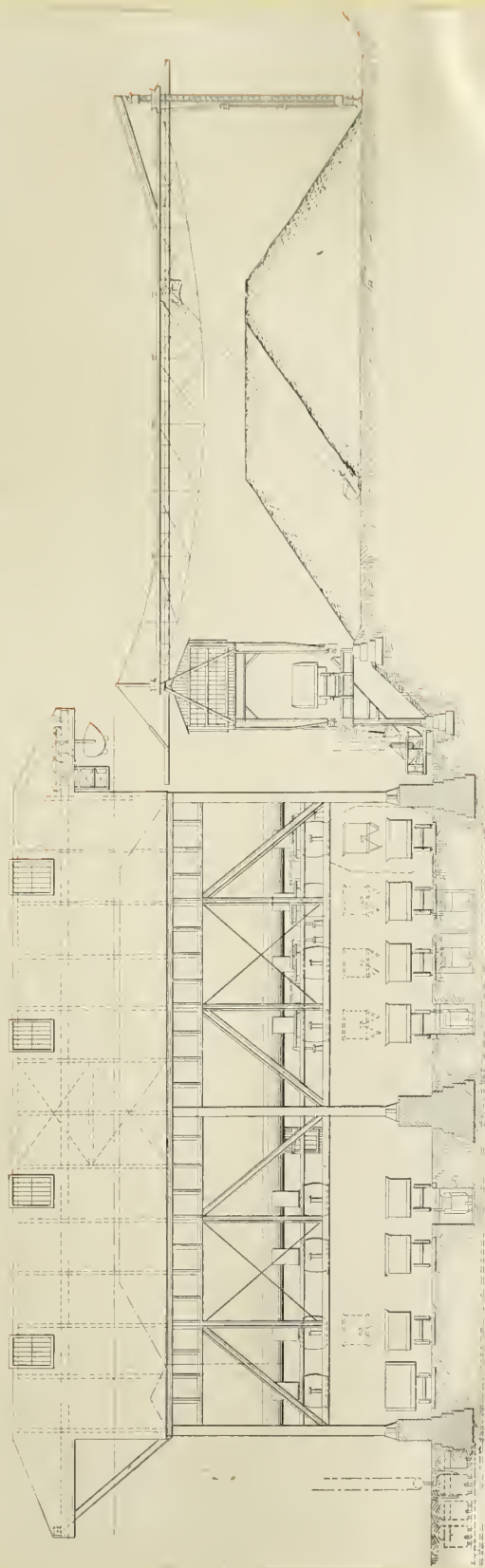


FIGURE 7. COMBINATION FUELING- AND COAL-STORAGE PLANT.

Fig. 29. "Hunt System"

II.

COST OF HANDLING COAL AT COALING STATIONS.

The cost of delivery of coal to locomotives is made up of the following items:

- 1-Interest on the Investment.
- 2-Depreciation.
- 3-Maintenance.
- 4-Operation.
- 5-Car rental where cars are used for storage purposes.

An accurate comparison of the cost data from various sources is difficult to make because of the differences in methods of keeping records and the variety of local condition.

Type "A" stations are only makeshifts and no careful records have been kept. The probable cost of labor is 25¢ to 50¢ per ton.

Type "B" stations show costs ranging from 17.5¢ per ton to 50¢ per ton. This wide variation may be attributed to the difference in labor prices, quantity handled daily, climate and other local conditions. The lower figure is from a station in the south, where the cost of negro labor is small and the amount handled is great enough so that the men are employed continuously. On the other hand the higher cost is from a station in Canada where the most trouble was caused by snow and sleet, and the consequent freezing of the coal so that it was necessary to loosen it with picks. The quantity handled was also small and the time spent in idleness by the laborers added materially to the cost per ton.

In type "C" stations the cost of handling is largely dependent on the cost of labor. In severe climates the coal may be stored under cover and the extra expense of handling frozen coal avoided.

The cost shown by various plants ranges from 15¢ per ton to 35¢ per ton, (See Table 1).

TABLE 1

COST OF COALING LOCOMOTIVES BY CRANE & BUCKET.

Line	Road	First Cost	Storage Tons	Daily Output tons	Cost Cts per Ton	Authority	Remarks
1	D.S.S.&A.	\$ 75	(crane)		15	A.of S.of B&B	Trestle \$ 9.60 per ft.
2	—	800		13	32	A.R.E.&M.of W	
3	—				35	A.of S.of B&B	
4	B.M.&F.D.			25	15	do	2 men @ 12½¢ per hr.

A.of S. of B&B. = Association of Railway Superintendents of Bridges and Buildings.

A.R.E. & M. of W. = American Railway Engineering and Maintenance of Way Association.

In the elevated trestle class of coaling plants the cost depends on the method of unloading the coal from the cars. In type 'D' where the coal is shoveled from gondola or box cars the cost of shoveling alone will be from 4¢ per ton to 11¢ per ton. When the coal is dumped directly from the cars to the pockets the cost of operation has been reduced to 1.1¢ per ton. This price is from a very large plant where 500 tons of coal per day are delivered in hopper bottom cars, and where no breaking is required. For costs of shoveling versus dumping, compare tables 2 & 3 .. In stations where mine run coal is handled the larger lumps must be broken up to prevent clogging of the chutes and to facilitate handling on the locomotive.

Another item which is important is the regularity of the supply of coal to the station and the regularity of the demand. The amount of coal that can be stored in the pockets is usually small unless

COST OF COALING LOCOMOTIVES BY ELEVATED TRESTLE.

TABLE 2

COAL SHOVELED FROM CARS.

Line	Road	First Cost.	Storage Tons.	Daily Output tons	Cost, Cts. per Ton.	Authority.	Remarks.
1	C.M.&ST.P.	\$1000	*		7.0	A.R.S. of B&B.	*Per pocket. Trestle \$1600
2	B.C.-R&N.	2550			10.0	do	
3	ST.L.&S.F.			143	7.4	do	
4	Wabash.	7170			6.1	do	
5	Mex. Cent.	4200			6.5	do	
6	C.R.I.&P.	1600			6.0-7.5	do	Approach \$4.50/ft.
7	M.&ST.L.	150	*		7.5-8.5	do	do
8	C.&E.I.	4400			5.5-6.6	do	
9	M.C.				10.0	A.R. M.M.A.	Shoveling 5¢/ton.
10	C.G.W.				6.0-9.0	do	
11	C.&N.W.				7.0	do	
12	A.T.&S.F.				6.0-7.0	do	
13	Vandalia				6.8	do	
14	I.C.				6.0	do	
15	Big Four				6.0	do	

Abbreviations - See Table 4.

TABLE 3.

SELF CLEARING CARS

Line.	Road	First Cost.	Storage Tons.	Daily Output tons	Cost, Cts. per Ton.	Authority.	Remarks.
1	N.&W.	\$6000			2.5-3.5	A.R.S. of B&B.	
2	Tex. Mid.	3760			21.0	do	Incl. storage incars.
3	P.&R.	22900			5.0	do	
4	G.N.	6500			3.0	do	Type F.
5	A.T.&S.F.	8000			3.0-4.0	do	" "
6	N.Y.C & H.R.				5.0	do	
7	D.M.&N.	3500			1.5-3.0	do	
8	Penna.	6200	230		2.5-3.0	do	
9	do.	6600	250		2.5-3.0	do	
10	Erie.				4.0	A.R.M.M.A.	
11	L.S.&M.S.			500	1.1	do	
12	C.B.&Q.				7.0	do	Total - incl. int. & dep.
13	C.&N.W.				5.0	do	
14	P.F.W.&C.				3.0	do	
15	I.C.				3.8	do	
16	B.&M.				7.0	do	" " " " "

(24)
the number of pockets is greatly increased above that required to satisfy the maximum demand between opportunities for refilling. It is usually considered expedient to have on hand at least forty-eight hours supply of coal to provide for emergencies. To meet this requirement, storage in cars is commonly resorted to. This is an extravagant practice as may be seen from the following example:

The average car holds forty tons and assuming that the ordinary demurrage charge of \$1.00 per day as the earning power of a car; the cost of car storage will be 2.5¢ per ton per day, or 5¢ per ton handled if forty-eight hours supply is kept on hand in cars. For data on cost of storage on cars in actual practice see column 10-table 5-

The cost of operating mechanical plants is largely dependent on whether or not the plant is operated to its fullest capacity or not. (Compare line 17 with line 20, Table 5.) When the coal can be handled from hopper bottom or side dump cars the cost of operation can be reduced to a very low figure.

In any mechanical plant where the coal is transferred from store to the chutes by any force other than gravity, the proportion of the coal which must be handled twice will materially affect the average cost per ton. (See Figure 29)
With the Hunt system, the C. & O. Railroad reports a cost of 2¢ per ton for handling the coal directly from cars to the stock bin or to the chutes. In a similar plant the P. & P. R. R. shows an average cost of 4¢ per ton for all coal delivered to the engines. This price includes labor, repairs and power, but not interest; and is divided as follows:

Elevation to storage,	per ton,	\$1.37
Delivery to Engines,	per ton,	2.67
Total,		\$4.04

The relative importance of the variations in cost of handling will be discussed in the next section, together with other considerations that affect the selection of the type of station.

TABLE 4.

COST OF COALING LOCOMOTIVES BY CONVEYOR PLANT.

Line	Road.	First Cost	Storage Tons	Daily Output tons.	Cost per Ton	Authority.	Remarks
1	D.&I.R.	\$ 4000			3.0	A. of R.S. of B.B.	
2	N.Y.C. & H.R.	9000	160		3.0-6.0	do	
3	do	15000	450		do	do	
4	do	9500	160		do	do	
5	do	19000	300		do	do	
6	do	22000	850		do	do	
7	do	24300	850		do	do	
8	do	18000	450		do	do	
9	do		820	360	2.7-3.6	RR Gazette	
10	M.C.	18000			3.5-5.0	A. of R.S. of B.B.	
11	do				5.0-10.0*	A.R.M.M.A.	* Coal shoveled from cars.
12	C. & O.				2.5	do	
13	ERIE				3.0	do	
14	B. & A.				11.2	do	
15	L.V.				6.0	do	
16	I.C.			300	7.6	do	
17	P. & R.				4.0	RR Gazette	Hunt System.
18	N. P.				7.0	A.R.E. & M. of W.	Fairbanks Morse
19	B. & O.	5000	120		2.5	RR Gazette	do
20	C. & N.W.		120		2.5	do	do
21	C. & W.M.				3.0	Eng. News	Link Belt Co.
22	B. & O.S.-W.	12000	500		2.7	do	do

A.R.S. of B. & B. = Association of Railway Superintendents of Bridges.

A.R.M.M.A. = American Railway Master Mechanics Association

A.R.E. & M. of W. = American Railway Engineering and Maintenance of Way Association.

TABLE 5.
ANALYSIS OF THE COST OF COALING LOCOMOTIVES

Line	No of Plants	Type	First Cost.	Tons Used per Day	% of Dump Cars	COST PER TON.						Remarks.
						Interest and Depreciation	Operation	Maintenance	Total	Car Rental	Total Incl. Car Rental.	
Col.	1	2	3	4	5	6	7	8	9	10	11	12
1	4	A&B	\$ 1150	157		0.2	10.4	0.1	10.7	6.6	17.3	Shoveled from R.R. cars
2	1	C	625	12		1.4	12.3	2.0	15.7	7.5	23.2	
3	1	C	800	13		1.7	20.6	2.2	24.5	7.5	32.0	
4	4	J	6850	235		0.8	10.3	0.5	11.6	6.2	17.8	
5	5	D	4850	133		1.0	11.3	0.5	12.8	4.7	17.5	
6	6	D&E	5600	305	90	0.5	3.1	0.5	4.1	5.0	9.1	
7	2	D	16000	370		1.2	6.1	0.6	7.9	4.3	12.2	
8	17	E	13000	444	100	0.8	3.6	0.4	4.8	5.0	9.8	
9	1	E	5600	67	75	2.3	2.8	0.1	5.2	5.0	10.2	
10	1	F	16400	264		1.7	3.5	0.8	6.0	5.2	11.2	
11	5	F	16400	166	large.	2.7	5.1	1.3	9.1	0.0	9.1	
12	55	F	8100	82	60-70	2.7	7.0	0.9	10.6	3.7	14.3	
13	3	I	10700	195		1.5	3.9	0.5	5.9	7.5	13.4	
14	6	H	17000	247	63	1.9	4.5	0.5	6.9	4.3	11.2	
15	1	H	9000	113		2.2	3.5	0.5	6.2	2.0	8.2	
16	1	H	6950	50	67	3.8	8.7	0.5	13.0	2.5	15.5	
17	1	G	22000	165		3.7	2.7	1.0	7.4	4.4	11.8	
18	1	G				2.0	4.9	1.6	8.5	5.8	14.3	
19	3	G	13400	147		2.4	3.7	1.0	7.1	4.1	11.3	
20	4	G	22700	345	80	1.8	2.4	0.5	4.7	4.7	9.4	
21	1	G	190000	450		11.6	2.8	2.1	16.5	1.9	18.4	
22	4	G	17400	280	90	1.7	2.7	0.5	4.9	4.4	9.3	
23	1	G	14800	127		3.2	4.3	0.6	8.1	4.1	12.2	
24	1	G	26200	218		3.3	3.1	0.5	6.9	0.0	6.9	
												* Estimated.
												(26)

* Estimated.

APPLICABILITY OF THE VARIOUS TYPES.

The principal factors which influence the selection of the type of a coaling station to be erected at a given point are as follows:

- 1-Location, kind of service required, and amount of space available.
- 2-Quantity to be handled.
- 3-Cost of Operation.
- 4-First Cost of Maintenance.
- 5-Amount of storage required.
- 6-Kind of Coal to be handled.
- 7-Manner of delivery to station.

Location and Kind of Service-The requirements for a terminal coaling plant are very different from those for an auxilliary station at some point out on the road. In the case of the terminal station the topography of the entire yard must be studied, and the coaling station and its appurtenances planned so as to give the greatest ease in handling locomotives to and from the engine house. In this connection there must be considered the character and amount of the traffic to be handled, whether the demand for engines is fairly constant throughout the day or whether the plant is liable to be taxed heavily for a few hours during the day. If the plant is located at a large yard it is often necessary to provide means for handling switching engines without interfering with the movements of road engines between the main tracks and the round house, and at the same time to care for the yard engines without a minimum delay. The facility with which coal cars can be handled is also important. The coal chutes, the water tanks, the ash pits and the sand house are all parts of the plant for handling locomotives, and no part of it should

be designed without due consideration of the other parts. The track arrangement should be designed so as to give the best results for the whole plant. In large cities the amount of space occupied by the station is important. In St. Louis the ground rental in the teaming yards of the Terminal Railway Company is estimated at \$3.00 per day per car, and only a little over 1000 square feet of space is required for a car and the adjacent team space. While this figure is probably much higher than the average for a whole system of terminal yards, the use of the ground covered by an approach trestle or tracks and storage platform for a crane plant, would be worth several hundred dollars per year to a railroad company. Out on the road the topography of the site, the question of erection and operation, and the time element are controlling factors.

Quantities to be Handled-The amount of the investment in a coal-plant that is justified depends on the amount of coal to be handled, and the rate at which it must be delivered to the engines. The American Maintenance of Way Association considers that a mechanical plant is justified by a consumption of 130 tons per day. They base this conclusion on the facts that for a smaller output than 130 tons per day, the maintenance charges are not functions of the quantity handled; that the charge per ton for wages is unduly high, because a competent engineer must be kept at the plant a large part of the time in idleness, and that the interest and depreciation per ton are excessive. The second objection is obviated when the conveying machinery can be operated by the same man who operates the pumps at a water station.

For small terminal stations very good results have been obtained by the use of locomotive cranes.

Fig.30.



Figure 6. Brownhoist Locomotive-coaling Crane.
Eight wheels, M. C. B. trucks and couplers.

While it is true that a skilled operator must be paid, the interest charge ^{is more} in the case of the conveyor plant, and the crane is available for handling ashes and for light wrecking, (See Figures 30 & 31). They are very convenient in a yard where changes are contemplated as the plant can be conveniently shifted to meet temporary requirements.

Fig.31.

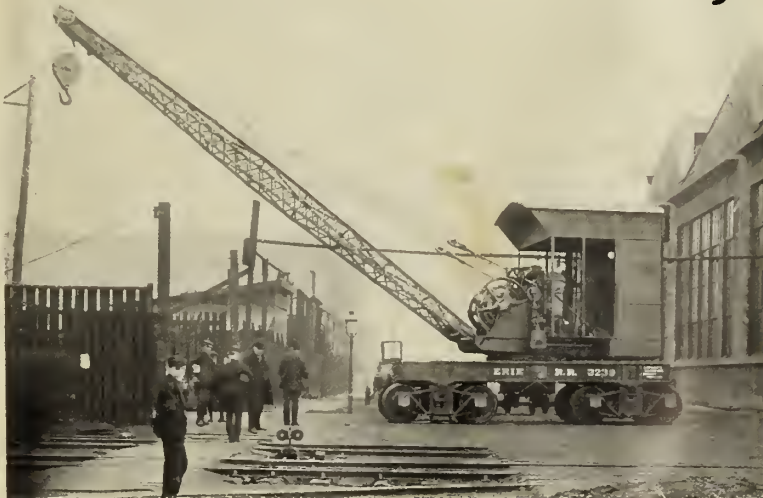


Figure 7. Brownhoist Locomotive-coaling Crane.
With grab-bucket removed and bottom-block substituted.
As used for light wrecking. Capacity, 14 tons at 15 feet radius

In one or two cases a locomotive crane is maintained for use in case of accident to the main plant, or a sudden rush of business for a short time.

3-Cost of Operation-The cost of operation for plants of the same design is governed by the cost of labor. Near large cities when labor is expensive the desirability of a mechanical plant is increased, while on the other hand the probable cost of power is higher in the rural districts. Continuous operation of the conveying machinery is rarely necessary in mechanical plants, and therefore electric power gives economical results where the plant is located at a point where ~~this~~ kind of power can be obtained cheaply, because it costs nothing when not in use. Where electric power is not available gasoline engines are superior to steam because they do not require fuel and attention when idle.

4-First Cost and Maintenance-The amount of extra expenditure which is justified to reduce maintenance charges can be determined only by experience. The charge for maintenance is slightly higher for conveyor plants than for the other types, on account of the great number of wearing parts. Any attempt to save in the cost of chain conveyors by making the machinery light is liable to end in disaster. An instance of the kind is cited in the Engineering News of April 19, 1908. In this case the conveyor was so racked and worn at the end of eighteen months' service as to be almost worthless. In belt conveyor plants the cost of belt renewals is about .2¢ per ton or about 40% of the total cost of maintenance. Any steel structure which extends over the track should be amply protected against corrosion by locomotive gases. Some roads accomplish this by covering them with cement plaster.

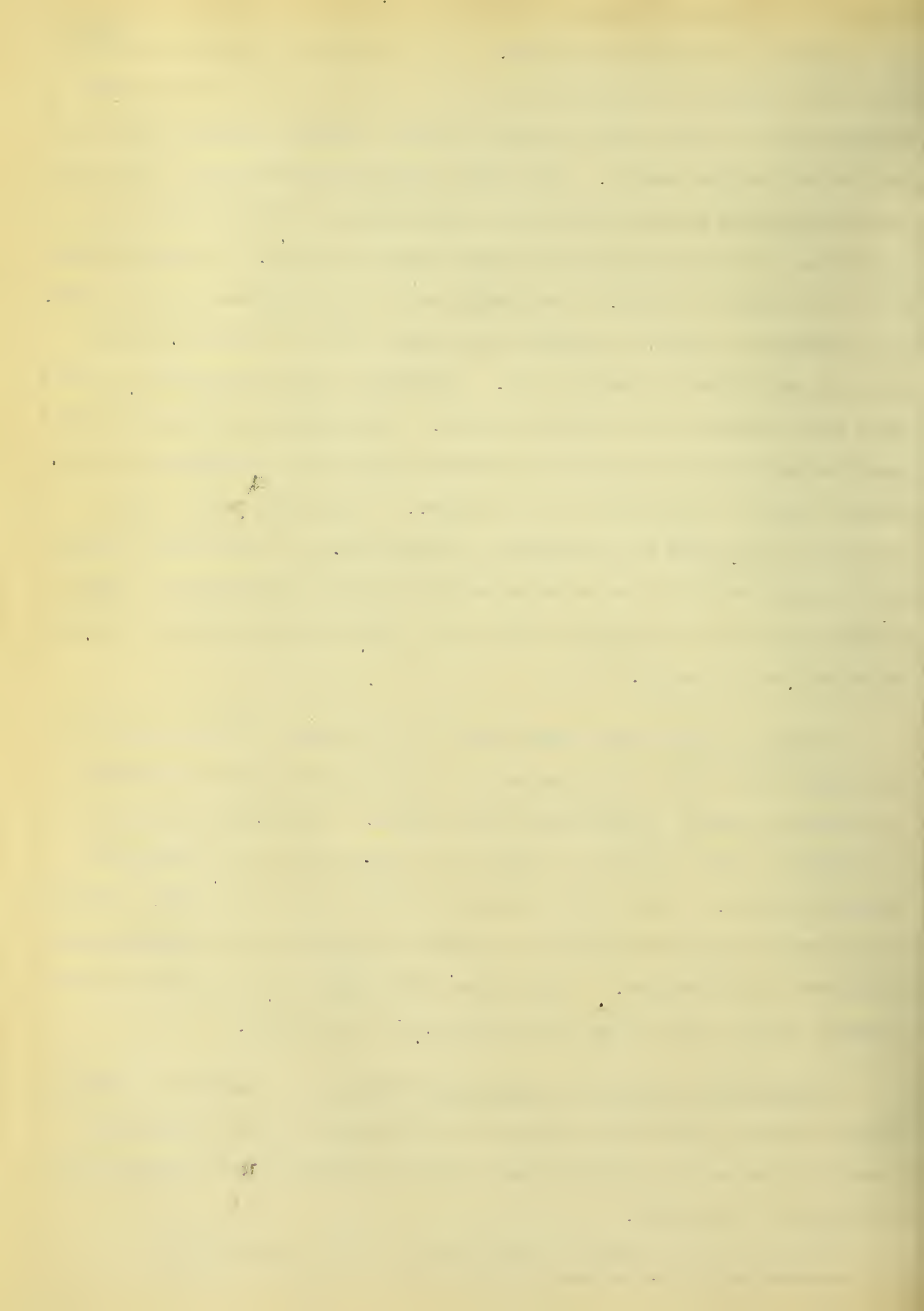
5-Amount of Storage Required-The question of storage merits more consideration than is generally given to it. A study of columns 9 and 10 of table 5, will show how large the cost of storage

is compared to the other charges. It is stated on good authority that the storage of locomotive coal in cars costs the Pennsylvania System \$300,000 per annum and the Illinois Central Railroad \$500,000 per annum for car rental. The same authority referring to the Pennsylvania System further states, "An expenditure of \$4,000,000 is justified to avoid holding two days' supply in cars." This amounts to an investment of \$61.00 for each ton of coal consumed in one year. The assumption of \$1.00 per day car rental for a 40 ton car is the same as that made in Section III. Interest and depreciation in this case were assumed to be 15% per annum. The amount of storage which must be provided in a given case depends upon the regularity of the supply and the uniformity of the demand. At points where large storage is required the mechanical plants have the advantage because they do not require that cars be held to store their reserve supply because the large overhead storage bins admit of cars being promptly unloaded and released.

6-Kind of Coal-Large lump costs on an average $1\frac{1}{2}\text{¢}$ per ton more to handle than fine coal because the larger pieces must be broken to prevent jamming in machinery and chutes. This may be done by providing a heavy grating to catch the lumps above the pockets of gravity chutes. Lumps thus caught are then broken by hand. Plants which handle the coal entirely in skips or buckets are comparatively free from this trouble. Large lump coal spills badly from belt conveyors, and is apt to jam chain and bucket conveyors.

7-Manner of Delivery to Station-Switching of coal cars at auxiliary stations where the cars must be delivered on the trestle by road engines is more troublesome than at terminal plants where switch engines are available.

*Bulletin 83, American Maintenance of Way Association.



Added to this is the delay to trains which is often a serious matter where traffic is heavy. A plant of the trestle type when the cars are placed by cable and hoisting engine, can be operated in conjunction with a water station at a very low cost for both. A conveyor plant, where the amount of coal and the storage required warrant the higher first cost, can be operated cheaply where one engineer serves both the pumping and conveying machinery. A special device is illustrated on the following page to show how unusual local conditions may be taken advantage of to secure economical results.

At terminal stations switch engines are usually available for placing cars and removing them *when empty*, but with that exception the conditions are the same for small terminal stations as for main line stations.

The kind of cars in which the coal is delivered is an important factor in the cost of handling at any station. An illustration of the comparative cost of unloading and elevating coal is furnished by the Illinois Central Railroad plant at 26th Street, Chicago. The coal was shoveled from ordinary gondola cars, and the figures are for a period of eighteen months during which an average of 300 tons per day was handled.

Total amount of coal handled,	164,643	Tons.
	Total	Per Ton.
Wages of men unloading coal	\$ 10129.11	6.15¢
Repairs on machinery,	1452.76	0.88¢
Wages of Engineer,	900.00	0.55¢
Total,	\$ 12481.87	7.58¢

This cost could be reduced about 50% by the use of hopper bottomed cars, (See lines 20 and 22, table 5).



THE BROWN HOISTING
Locomotive-coaling Station built for the BALTIMORE & OHIO RAILROAD at Kings Island



G MACHINERY CO.
s, Ohio. Showing Coal-pocket being filled by "BROWNHOIST" Cableway from mine

11

Fig. 32.

IV.

CONCLUSION.

A study of the data here presented and the opinions of many railroad men point to the conclusion that a trestle plant using hopper bottomed cars is the cheapest plant to build, maintain and operate where the following conditions obtain.

1-When the daily consumption is less than 130 tons per day.

2-When the supply is sufficiently regular to admit of a small reserve and the quick release of cars.

3-Where sufficient space is available, and when the ground rental is not large.

When ground rental is high enough to make the question of space important, when the quantity of coal to be handled is more than 130 tons per day, and when a considerable amount of storage is required, a conveyor or other form of mechanical elevating plant with overhead storage bins gives the best service.

Locomotive crane plants give good service for small terminal plants but are not applicable to large stations because they are slow, and if any large amount of coal is to be stored a large number of cars must constantly be held at the station or a large ground space devoted to the storage of coal.

The largest single item of expense at stations where the coal is delivered in ordinary gondola cars is the cost of unloading the cars, and therefore the most logical way to decrease the cost of handling locomotive coal is by the more general use of self-clearing cars, where they are available for general traffic; and the use of plants which unload by means of a grab bucket where ordinary gondolas are used.

V.

ASH PITS.

The handling of locomotive cinders is closely related to the subject of locomotive coaling stations, and therefore the common forms of ash pits and handling devices will be briefly discussed with reference to their advantages, disadvantages, and cost.

1-Iron Troughs-The simplest form of ash pit is a shallow iron trough placed between the rails on top of the ties, from which the ashes are shoveled by hand. The device is only applicable to small branch lines, and therefore will not be discussed here.

2-Closed Depressed Pits-Closed depressed pits are very commonly employed. The track is carried on the walls of the pit, which are either brick or concrete, or on separate foundations. The ashes are removed either by shoveling or by crane and buckets. This type of pit is very unsatisfactory for several reasons. First, the operating cost is high where the work is done by hand because the cinders must be handled twice unless the ash car track is depressed several feet below the bottom of the pit. Second, the work of cleaning must be suspended while engines are passing over the pit, and the ashes allowed to accumulate. Third, in severe climates this accumulation is apt to freeze owing to the amount of water used to wet the ashes down. Fourth, the problem of drainage is difficult and the constant attention required to keep drains in order makes the maintenance cost very high. Pits of this type cost about \$10.00 per foot of effective length. A pit 55 feet long will accommodate one engine, and one 90 feet long will serve two at once. Removal of ashes by hand costs 12¢ per cubic yard, and by crane 6¢ per cubic yard.



Fig. 33.

PNEUMATIC ASH HOIST

PENNSYLVANIA RAILROAD. ASHES FROM ENGINES ARE DISCHARGED INTO PIT CARS; THESE ARE PUSHED UNDER BRIDGE. THE PIT CAR IS THEN LIFTED FREE OF TRUCK BY AIR CYLINDER, CARRIED OVER RAILROAD CAR AND DUMPED.

The Link - Belt Companies

THE method of handling cinders here shown possesses the merit of being economical in first cost and maintenance. It consists merely of a steel pocket lined with concrete and having overhead trolley tracks spanning one or more cinder pits. Locomotives discharge fire box cinders and flue dust simultaneously into pit tubs, which are then elevated and dumped into the pocket.

Suitable machinery is provided for operating trolley wagons on overhead track and for raising, lowering and dumping the tubs.

The view on opposite page shows a single 50-ton pocket provided with two overhead tracks spanning four pits, while the plant shown below has a single track spanning two pits. As each pit is sufficiently long to accommodate two engines, eight can be cleaned simultaneously at the former and four at the latter point.



CINDER STATION, P. & L. E. R. R., GROVETON, PA.

3-Cinder Trestles-The necessity for a pit is obviated and the drainage problem much simplified by running the engines on a raised track and discharging cinders through a trestle. The cost of handling is materially reduced if the ash car track is depressed below the level of the shoveling platform. This arrangement has the advantage that the work of removal can be carried on simultaneously with the cleaning of engines. The total cost of such a plant varies from \$12.00 per foot to \$17.00 per foot about equally divided between the trestle and the ash car track. In one case where the subsoil was particularly bad the cost was \$25.00 per foot. The cost of loading cinders is from 3.5¢ per cubic yard to 4.5¢ per cubic yard, and the total cost including the cleaning of fires and ash pans ranges from 30¢ to 32¢ per engine.

4-High Trestle-The Central Railroad of New Jersey uses a higher form of trestle than that discussed in the previous article, costing about \$25.00 per foot. The cinders are allowed to accumulate until a sufficient quantity has been deposited to make it worthwhile for a work train to remove them. The advantages claimed for this system are, that it saves continual shifting of ash cars, and that a large quantity of ashes can be wasted to a better advantage than a small one. Notwithstanding the fact that these plants have been very satisfactory on the Central of New Jersey, no plants of the same type have been built on other roads.

5-Open Side Depressed Pits-The most satisfactory form of ash pit that has yet been devised is a depressed pit with one side open. A pit of this kind where ashes are handled by locomotive crane and grab bucket, is shown in figure 34. If the ashes are to be shoveled by hand the ^{ash} car track is depressed about 6 feet below the level of



Figure 2. Brownhoist Locomotive-coaling Crane.

At Willson Avenue Station, Erie Railroad, Cleveland, Ohio, showing method of taking ashes out of ash-pit.

"Ashes are taken from the pit and deposited in cars on adjacent tracks."

Fig. 34.

the shoveling platform which is then left entirely open on that side. This form admits of loading cinders at the same time that engines are being cleaned and requires no approach above the general level of the yard. To prevent uneven settlement both sides of the engine track should be supported in the same manner. This is best done by building a steel trestle to carry the track and to support the track rails by inverted rails or I beams between the bents. Old rails may be used to advantage for a large part of this structure. There are several methods of applying power to remove ashes from this type of pit. In the type of pit shown the ashes roll out to the side by gravity and are picked up by the crane. In another form wheeled skips barrows are placed under the engine to receive the cinders and then are moved to one side, and replaced by empty ones while the first are being emptied. Jib cranes operated by

hand, or lifting by air and turned by hand are used successfully for small plants; and locomotive or traveling cranes are installed for the larger pits. These plants cost about \$18.00 per foot without crane and about \$42.00 for a large pit complete with skips and hoisting machinery. The cost of operation varies from 33¢ per cubic yard for power hoisting to 6.7¢ for hand labor.

6-Open Side Pits, Water Handling-The Southern Pacific Railroad Company has installed a unique open side pit in which the top of the ash car is depressed below the floor of the pit and the cinders washed down a slope into the cars. This scheme is open to two objections; first, the difficulty of draining the deep ash car pit; and second, the large quantity of water required. Neither would this method be applicable when freezing weather might be expected.

7-Conveyor Plants-Both screw and bucket conveyors have been tried and abandoned by many roads, because the conveyor pits are hard to drain, and the trouble from freezing in cold weather is very hard to overcome. The water draining from the ashes contains compounds which are very destructive to the steel of the conveyors. These defects make conveyor plants more expensive to maintain and less reliable in operation than those operated by hand labor or by cranes and buckets.



ASHES HANDLING PLANT
RECENTLY COMPLETED FOR THE PITTSBURGH & LAKE ERIE
RAILROAD, HAZELTON, OHIO.

Fig. 35.

The Link-Belt Companies



SECTION OF MALLEABLE
IRON BUCKET CARRIER

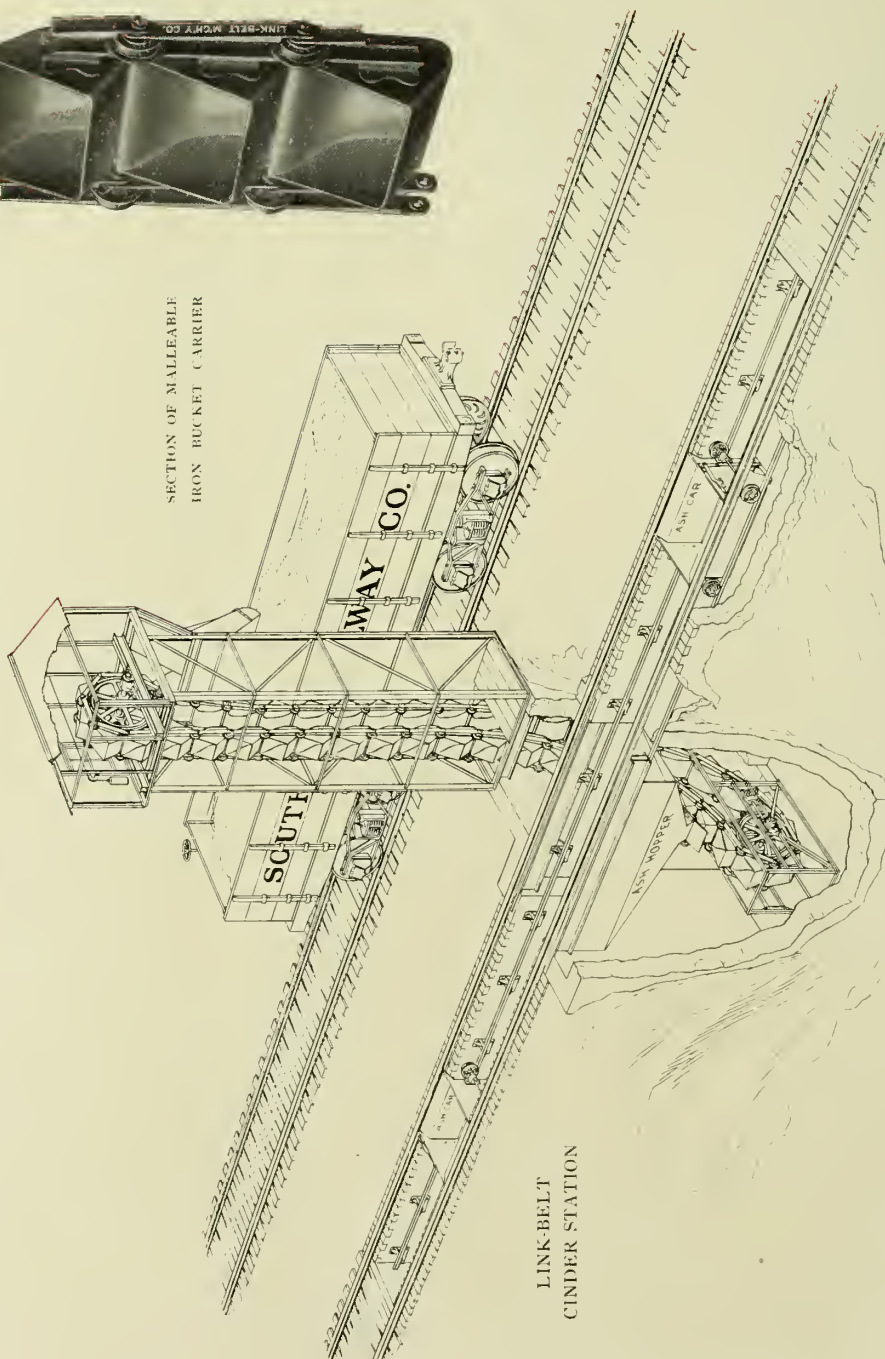


Fig.36.



Fig 37

LOCOMOTIVE COALING STATION AND ASHES HANDLING PLANT
ERIE RAILROAD, PORT JERVIS, N. Y. TERMINAL TYPE. COAL HOPPER CAPACITY 2,500 TONS. BY MEANS OF TWO
AUTOMATIC FEEDERS, SITUATED BELOW TRACK HOPPERS, DIFFERENT SIZES OF COAL ARE MIXED IN ANY DESIRED
PROPORTION. ASHES HOPPER CAPACITY 120 TONS. FOUR ENGINES CAN CLEAN PANS SIMULTANEOUSLY.

The Link - Belt Companies

The Modern Link-Belt Cinder Station

PERMITS the rapid cleaning of ash pans, automatically receives and deposits the cinders into cars or pockets, does the work quickly, at small cost and by machinery which is durable.

The Link-Belt Carrier is practically a continuous series of small cars, by which the cinders are received from hopper, and discharged into pocket, with none of the dredging or scraping friction so destructive to elevators and conveyors of ordinary type.

It handles cinders more rapidly than any other medium, and requires so little attention that one man can operate the machinery and hoist both coal and cinders at a combined station of medium size.

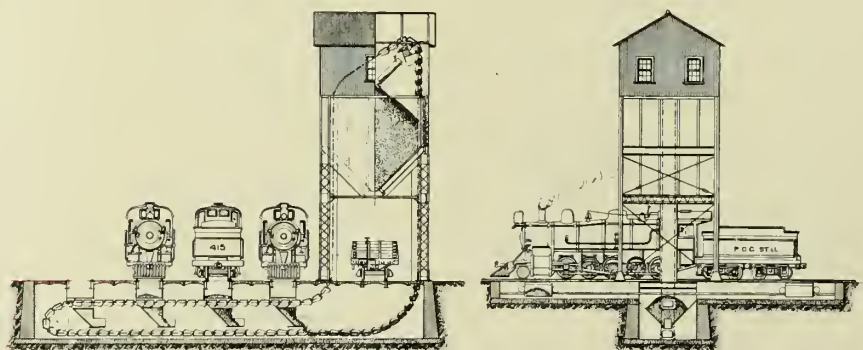


DIAGRAM OF CINDER STATION, SHOWN ON OPPOSITE PAGE

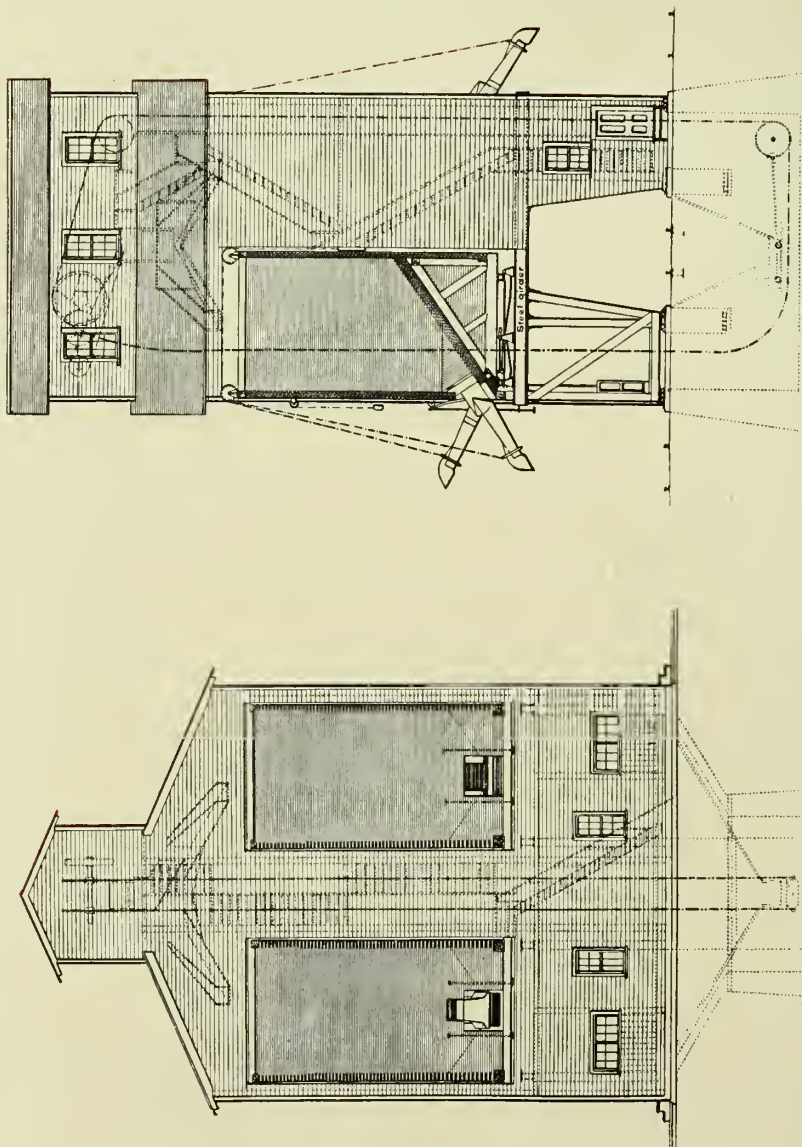
Fig. 38.



Fig. 39.

LOCOMOTIVE CINDER STATION
INSTALLED IN 1902 FOR THE PENNSYLVANIA LINES WEST OF PITTSBURG
SOUTH-WEST SYSTEM, COLUMBUS, OHIO. SEE DIAGRAM ON OPPOSITE PAGE

The Link-Belt Companies



DESIGN FOR MAIN LINE OR TERMINAL COALING STATION, HAVING FOUR SCALE POCKETS FACING TWO TRACKS.
OPERATED BY ONE MAN.

REFERENCES.

Coaling Stations.

- 1-Proc. American Engineering and Maintenance of Way Association; Vol. 3, P. 149-163, 179-199.
- 2-Bulletin 83, Maintenance of Way Association.
- 3-Proc. Association of Railway Superintendents of Bridges and Buildings; Vol. 12, P. 78-133; Illus.
- 4-Proc. American Master Mechanics' Association; Vol. 34, P. 248-266; Vol. 35, P. 148-156.
- 5-Railroad Gazette, June 16, 1882.
- 6-Railroad Gazette, Sept. 15, 1882; Platform Systems.
- 7-Railroad Gazette, Oct. 5, 1883; Auxilliary Stations.
- 8-Railroad Gazette, April 1, 1887; Traveling crane coaling Station.
- 9-Engineering News, Nov. 10, 1892.
- 10-Railroad Gazette, May 3, 1895; Dodge System, $1\frac{1}{2}$ col. Illus.
- 11-American Engineering & Railroad Journal, May, 1896, $1\frac{1}{2}$ col. Illus.
- 12-Railroad Gazette, March 18, 1901; New York Central Plant at Syracuse, 1 Page Illus.
- 13-Railroad Gazette, Feb. 5, 1902, Feb. 19, 1902; Railroad Engine houses by C. L. Berg, $3\frac{1}{2}$ Pages Illus.
- 14-Railroad Gazette, March 14, 1902; New System of Coaling Stations on the C. & A. R'y.

- 15-Railroad Gazette, May 13, 1902, 1½ Pages Illus. Coal Storage Plant.
- 16-Railroad Gazette, June 20, 1902; Requirements for Coaling Plants.
- 17-Railroad Gazette, Oct. 31, 1902, P. 830; Investigation of Coaling Plants.
- 18-Railroad Gazette, 1902, P. 94-96, 132-133.
- 19-Railroad Gazette, 1902, P. 300-400; Cost Data.
- 20-Railroad Gazette, 1902, P. 687; Link Belt Plant at Hoboken, New Jersey.
- 21-Railroad Gazette, 1902, P. 956; Pennsylvania Station at Chicago.
- 22-Railroad Gazette, 1902, P. 815.
- 23-American Engineering and Railway Journal, February, 1904.
- 24-Railroad Gazette, May 13, 1905.
- 25-Engineering Record, April 14, 1906; 1 1/3 Pages.
- 26-Engineering News, June 14, 1906; Reinforced Concrete Station
- 27-Railroad Gazette, March 29, 1907; Report of Convention, American Maintenance of Way Association; 7000 words.
- 28-Engineering Record, April 27, 1907. 2 col Illus.
- 29-Engineering News, April 19, 1908. 2 Pages, Illus; tables.

Cinder Pits.

- 1-Proc. Association of Railway Superintendents of Bridges and Buildings; Vol. 3, 44 Pages Illus.
- 2-Proc. American Railway Engineering and Maintenance of Way Association; Vol. 5, P. 571.
- 3-Engineering News; Aug. 8, 1890, 1 Col. Illus. Cinder Loading Plant.

4-Railway and Locomotive Engineering, January, 1906, 2 Pages

Illus.

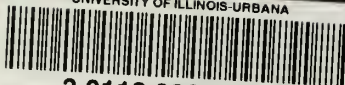
5-Engineering News, March 22, 1906, 1 $\frac{1}{2}$ Page Illus.

6-Engineering Record, March 16, 1907; 800 words.





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